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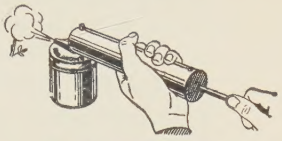

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DEAN (R. W.). **Experiments on rearing Apple Maggot Adults.**—*J. econ. Ent.* **31** no. 2 pp. 241–244, 1 fig., 5 refs. Menasha, Wis., April 1938.

During 1931–32 and 1935–37, 188 experiments were made in New York with different foods and types of cages for adults of *Rhagoletis pomonella*, Walsh. The flies used were first-generation individuals collected daily from soil emergence cages and transferred to the experimental cages within 24 hours of emergence. The most satisfactory cage was one measuring $6 \times 7 \times 8$ ins., having a wooden bottom and frame and a muslin covering on the sides and one end, the other end being formed by a sleeve and the top by a sliding glass plate. Heavy mortality was caused in early tests by the fermenting of food materials. In later tests only non-fermentable solutions were used. Sugars and combinations of proteins with sugar were administered by making a thick syrup of the sugar with distilled water, and stirring the dry powdered protein into it. The mixture was then smeared on the glass top. Distilled water and solutions were given separately in small, wide-mouthed bottles inverted on filter paper disks in Petri dishes. Unripe apples were suspended in the cages for oviposition. Experiments were made in the insectary with no control of temperature or humidity and in a rearing cabinet in the laboratory at 30°C. [86°F.] and 75 per cent. relative humidity. To survive and produce eggs, the flies needed a constant supply of water, sugar and a food containing nitrogen. Lack of either of the first two resulted in rapid death, even after a previous period of feeding on both. With sugar and water only, the length of life was greatly increased, but few, if any, eggs were laid. The addition of a non-protein source of nitrogen increased egg production somewhat, while the addition of a protein food increased it greatly. Of the carbohydrates tested, honey and sucrose were the best, though very few eggs were laid with any. Of the proteins tested with sucrose (2 parts sugar to 1 part protein) and distilled water, Proteose-peptone and yeast were far the most effective. The effect of the addition of certain inorganic salts to the diet was studied, but in general they did not markedly affect oviposition. Unmated females laid fewer eggs than mated ones. Most eggs were obtained when equal numbers of males and females were used. The preoviposition period was almost always shorter in the insectary than in the laboratory and more eggs were obtained, except when Proteose-peptone was given. This exception was probably due to the hygroscopic properties of the material, which, on exposure to the high humidity prevailing at night, becomes very sticky. Many flies were lost when they became stuck to the food smear. To improve its physical character, an equal part of yeast powder was added, and increased oviposition resulted in the insectary. It is suggested that the superiority of results obtained in the insectary may be due to fluctuating temperature and humidity or the suitability of conditions for the growth of beneficial micro-organisms on the food.

HAMMER (O. H.). **The Scurfy Scale and its Control.**—*J. econ. Ent.* **31** no. 2 pp. 244–249, 3 figs., 1 ref. Menasha, Wis., April 1938.

The following is substantially the author's summary: *Chionaspis furfura*, Fitch, although of no importance in most commercial apple orchards in New York state, is exceedingly destructive in a small

(1988) Wt. P9/3656 1700 10/38 S.E.R. Ltd. Gp. 353 [A] A

area in northern Dutchess and southern Columbia counties. There are commonly, if not always, two broods of the insect annually in this section. The overwintered eggs hatch over the period from about 10th May to 5th June. Eggs laid by the first-brood females hatch during the second half of July. The first-brood scales infest mainly the old wood, whereas many of the second-brood scales infest the new wood and fruit. The experiments described indicate that the scale can be controlled either with dormant or foliage sprays. Dormant applications of coal-tar oil emulsions containing 4·5 per cent. actual tar oils gave consistently good results over a three-year period. Combinations of tar oil and lubricating oil emulsions containing not less than 3 per cent. total oils also proved highly effective, with the toxicity increasing as the total oil content of the spray was increased. A 6 per cent. lubricating oil emulsion was about equal to 4·5 per cent. tar oil emulsion. All dilutions of lubricating oil emulsions containing dinitro-o-cyclohexylphenol tested (1–4 per cent.) gave an efficiency of 95 per cent. or better. Liquid lime-sulphur used at the rate of 12 gallons in 100 gallons of spray was of little value. Of the several materials tested as foliage treatments to kill the crawlers, 1½ per cent. summer oil emulsion, alone or with nicotine sulphate (1 : 800) and a proprietary bentonite nicotine (1½ U.S. pints nicotine oleate and 4 lb. bentonite fixator) reduced fruit infestations by about 72, 87 and 70 per cent., respectively.

HARTZELL (F. Z.), MOORE (J. B.) & GREENWOOD (D. E.). **Control of Eye-spotted Budmoth on Apple by lubricating Oil containing Dinitro-o-cyclohexylphenol.**—*J. econ. Ent.* **31** no. 2 pp. 249–253, 2 refs. Menasha, Wis., April 1938.

The following is based on the authors' conclusions from this summary of the results of orchard tests during 1936 and 1937 of dormant sprays of lubricating oil containing dinitro-o-cyclohexylphenol against larvae of *Eucosma* (*Spilonota*) *ocellana*, Schiff., on apple in New York. Sprays containing 3 per cent. of a solution of dinitro-o-cyclohexylphenol (4 per cent.) in lubricating oil (96 per cent.) give effective control, the efficiency increasing with an increase in concentration up to and including 3 per cent. but not beyond. In general, diluted spray emulsions of the same strength gave similar results regardless of the manner in which they were prepared or the kind of emulsion used. The effectiveness of mixtures containing practically the same amount of oil varied with the amount of dinitro-o-cyclohexylphenol, and that of those containing approximately the same amount of the latter was increased somewhat by increasing the quantity of oil. Two kinds of lubricating oil, the specifications of which are given, were used in the experiments, and, at similar concentrations, gave similar results. Lubricating oil at 3 per cent. without dinitro-o-cyclohexylphenol did not give commercial control.

BECKWITH (C. S.). *Sparganothis sulfureana* **Clem., a Cranberry Pest in New Jersey.**—*J. econ. Ent.* **31** no. 2 pp. 253–256, 7 refs. Menasha, Wis., April 1938.

Sparganothis sulfureana, Clem., has a wide range of food-plants and is known to occur in most of the United States except the south-west. A description of the adult published in 1884 by S. A. Forbes is quoted.

The larvae damage cranberries by destroying the fruit buds, webbing and eating the foliage and mining the fruit. All these types of damage were important in New Jersey in 1935 and 1936, but the mining of the fruit was the most so. Each summer-brood larva mined 3–5 berries, about two-thirds of the crop on two bogs being destroyed in this way.

Observations on the seasonal history were made in an outdoor insectary and checked by field observations. Adults emerged in September 1936 and oviposited within 2 days. The eggs were laid in masses on the upper surface of the cranberry leaves and hatched in 9–12 days. The young larvae made a small web as a shelter on the under side of the leaf or on the stem ; they ate very little and did not grow at all during the autumn and winter. Towards the end of April, they left their tents and began to feed on the terminal buds. Later, they attacked the young growth, webbing the leaves together and skeletonising them. In the insectary, the first pupae were observed on 30th May 1937, and the last of the same generation on 20th June. The pupal stage, which was passed in the web, lasted 7–12 days. The first adults emerged on 6th June and the last during the first week in July. Adults were abundant on the infested cranberry bogs during the second half of June and the first week of July, and summer-generation eggs were first observed on 21st June and were numerous during the first half of July. The egg stage was of the same duration as in the autumn. The larvae began to feed on the foliage and in some instances on the bloom, but preferred the fruit and attacked it almost exclusively after the berries were half-grown. They pupated inside the berries between 2nd August and 27th September, but principally during the last week of August and early in September. Eggs were found in the cages from 11th August till November, and most appeared between 6th and 26th September. A few of the resulting larvae fed and grew during September, but none reached the pupal stage ; it is possible that these individuals do not survive the winter.

The young larvae endure the usual winter submergence of the bog for 5½ months, and nearly mature larvae submerged for 48 hours were not killed. Cage tests indicated that the adults could be destroyed by a pyrethrum dust (0·9 per cent. pyrethrins) at the rate of 30 lb. per acre, but, on account of the irregularity of emergence, dusting against them was not considered practical. An application of 15 lb. derris dust (4 per cent. rotenone) per acre by aeroplane was not effective in killing larvae on 2nd June 1937. Effective control was obtained with lead arsenate (2 lb. in 50 U.S. gals.) added to the spray of Bordeaux mixture and soap applied on 3rd and 4th June and used at the rate of 200–300 U.S. gals. per acre. The parasites present in the material collected in early September 1936 were *Nemorilla floralis*, Fall., *Anachaetopsis tortricis*, Coq., *Meteorus trachynotus*, Vier., *Microbracon mellitor*, Say, *M. gelechiae*, Ashm., *Sympiesis ancylae*, Gir., *Oncophanes atriceps*, Ashm., and *Angitia paenerivalis*, Vier.

The presence of larvae of *S. sulfureana*, which are black-headed at one time and yellow-headed at another, complicates the rapid identification of the common pests of cranberry in New Jersey. In general, they brown the leaves less than the yellow-headed fireworm, *Peronea minuta*, Rob., or the black-headed fireworm, *Rhopobota naevana*, Hb. (*vacciniana*, Pack.), and make a smaller web, and the hole in the fruit is clean, unlike that made by *Mineola vaccinii*, Riley, which is usually partly filled with frass. Moreover, *M. vaccinii* very rarely pupates in the fruit.

CARRUTH (L. A.). **Southern Corn Shipments and their Relation to Corn Ear Worm Infestations on Long Island.**—*J. econ. Ent.* **31** no. 2 pp. 256–259, 3 refs. Menasha, Wis., April 1938.

In an attempt to establish the source of early summer infestations of maize by *Heliothis armigera*, Hb. (*obsoleta*, F.) in the latitude of Long Island, an examination was made of 10 bushels of maize from southern states purchased in New York on 10 days in June and July 1936 and May, June and July 1937. Of the 552 ears, 73·3–100 per cent. showed injury, 12·8–46·3 per cent. contained living larvae, 0·0–29·2 per cent. contained mature living larvae, and 3·3–66·0 had no injury below the silk channel at the tip of the cob. Some larvae had been crushed during shipment and some lost during handling at the markets, and a number appeared to have died from disease and from conditions associated with refrigeration during shipment. A comparison of the amount of maize received from the south, the nature of the preceding winter and infestation of maize in Long Island by *H. armigera* in July in the four years 1934–37 failed to reveal any connection between the quantity of maize imported and subsequent infestation. In the 4 years, 358, 363, 303 and 177 carloads of maize were received, the winters were severe, average, severe and mild, and averages of 9·7, 23·3, 6·3 and 22·0 per cent. of the ears were infested. Examinations during the winters of 1934, 1935 and 1936 showed almost complete mortality of overwintering individuals, but a further study of pupal survival was made following the mild winter of 1936–37. During May and early June 1937, the soil was removed to a depth of 1 ft. from 10 plots, 10 ft. sq., in a field in which sweet maize had been grown and heavily infested during the previous season. Six live pupae were found and adults reared from them. This represents a survival of 250 per acre.

MENUSAN, jr. (H.). **Results of Potato dusting Experiments on organic Soils.**—*J. econ. Ent.* **31** no. 2 pp. 259–262. Menasha, Wis., April 1938.

Experiments were carried out from 1933 to 1937 on the spraying and dusting of potatoes on organic soils in western New York, where the luxuriant growth favours insect pests, the most numerous of which are *Empoasca fabae*, Harr., *Leptinotarsa decemlineata*, Say, *Epitrix cucumeris*, Harr., and Aphids (mainly *Myzus persicae*, Sulz.) involved in the spread of virus diseases. Bordeaux mixture (4 : 2 : 50) was applied at an average rate of 110 U.S. gals. per acre and dusts at 35–40 lb. per acre at each application. Applications were first made when injury by larvae of *L. decemlineata* began, and all plots, including the otherwise untreated controls, received calcium arsenate in the first application, for their control. In the three years 1933–35, there was no marked difference in the yield of plots dusted with copper sulphate and lime (20 : 80) or sprayed with Bordeaux mixture, although sprays gave a better control of the pests. Dusting and spraying increased yield significantly in 1933 only. This was attributed to the control of *Empoasca fabae*, which was a serious pest in that year. Spraying is more expensive and slower than dusting and causes greater mechanical injury. As local conditions are often unfavourable for the application of dusts of copper sulphate and lime, the dew being

insufficient, other dusts were tried. The most promising were those containing sulphur. Sulphur applied to dry foliage gave consistently better yields than copper sulphate and lime applied to wet foliage on the same day. In the dry seasons 1934 and 1936, the increases of yield of the sulphur-dusted plots over the control plots were statistically significant, but the differences between the yield of plots dusted with sulphur and copper sulphate were significant in 1936 only. Plots dusted with sulphur had smaller numbers of *Empoasca* and tarnished plant bugs [*Lygus pratensis*, L.], but larger numbers of *Epitrix* than plots dusted with copper sulphate. All the treated plots had fewer pests than the controls, except late in the season when they had more Aphids. The addition of contact insecticides, such as nicotine and pyrethrins, to sulphur dusts usually increased yield, but the increases were not significant and the additional cost was considerable. Limited experiments indicated no difference in the response of various varieties of potato to dusts or sprays, except those due to variability in time of maturity. The dilution of the dust of copper sulphate and lime with equal amounts of sulphur dust gave excellent results in 1937.

PEPPER (B. B.) & HAGMANN (L. E.). **The Carrot Weevil, *Listronotus latiusculus* (Boh.), a new Pest on Celery.**—*J. econ. Ent.* **31** no. 2 pp. 262–266, 1 fig., 11 refs. Menasha, Wis., April 1938.

Injury to celery plants in New Jersey in 1936 was found to be caused by *Listronotus latiusculus*, Boh. The history and distribution of this weevil in the United States, where it attacks carrots and parsley [*cf. R.A.E.*, A **12** 365 ; **14** 451 ; **16** 265], are reviewed. It is thought that it causes much of the injury to carrots in New Jersey attributed to the carrot rust fly [*Psila rosae*, F.]. Celery is the main crop grown on the muck soil in the five northernmost counties in New Jersey, but it was infested by *L. latiusculus* in one county in the north-east only. No preference between celery and carrot was shown. No signs of injury were found on celery on upland soils, though carrots in the neighbourhood were severely damaged. All plants growing near infested celery were examined for larvae, and *L. latiusculus* was reared from cultivated and wild carrots, parsley, plantain (*Plantago major*), dock (*Rumex patientia*) and dill (*Anethum graveolens*). No grubs or injury were found in *Sagittaria variabilis* [*cf.* **14** 451 ; **20** 366]. Celery may be injured at any time between planting out and harvesting, but no injury to seedlings in the greenhouse was observed. Young plants usually die, larger ones are often dwarfed and seldom recover, and tunnelling of the stalks renders the celery unfit for market. Frequently 50 per cent. of young celery was killed and 35 per cent. of celery ready for market injured. The adults feed in the groove of the large stalks.

There were three generations in New Jersey in 1937. Adults were found on young plants and eggs were present on 12th May. Eggs of the first and second generations hatched in 9–17 and 7–13 days, respectively. Larvae were found in the field on 20th May. They may feed in any part of the plant, but are most commonly found in the heart. Tunnels may be 12–14 ins. long, if the eggs are laid at the top of the stalk. The mature larvae crawl out of the plant and pupate in an earthen cell near the exit hole. The pupal stage lasts about 11 days

in the first generation and sometimes as little as 6 days in the second and third. The life-history in New Jersey is similar to that reported from Long Island [**16** 265]. The adults are sluggish and feign death when disturbed; they have been observed to fly a little, but it is doubtful whether they migrate very far. They pass the winter in grass and débris in and near the celery fields, and the elimination of suitable hibernation quarters, such as sod on the banks of drainage ditches, appears to lessen infestation in the following year.

As crop rotation is impracticable in New Jersey, experiments were carried out in 1936 with pyrethrum dust and dusts and sprays of derris, thiodiphenylamine (phenothiazine) and fixed nicotine. The only material that showed any promise was a dust of thiodiphenylamine and talc (20 : 80). In 1937, a commercial apple and sodium fluosilicate bait at 40 lb. per acre per application, a spray of 3 lb. calcium arsenate, 6 lb. lime, 1 lb. skim milk and 100 U.S. gals. water at 100 U.S. gals. per acre, and a dust of 25 lb. calcium arsenate, 73 lb. lime and 2 lb. skim milk at 30 lb. per acre each gave fair control of the first brood when the treatments were repeated four times, but a poison bran bait, as used against cutworms, gave practically no control. In tests against the second brood, in which four applications were made, of three baits and two dusts at the same rates as in the previous experiments, the commercial bait, a home-made bait of 90 lb. dried apples and 10 lb. Paris green, thiodiphenylamine and talc dust (1 : 9), calcium arsenate and lime dust (1 : 3), and a home-made bait of 40 lb. raisins, 40 lb. bran and 10 lb. Paris green reduced the percentage of injured and dead plants to 5·8, 6·0, 8·3, 9·3 and 12·1, respectively, the percentage dead and injured plants in two control plots being 21·1 and 40·9. The second control plot was in an adjoining field planted 10 days later than the test plots.

HUCKETT (H. C.). **Recent Problems on Long Island in the Control of Bean Insects.**—*J. econ. Ent.* **31** no. 2 pp. 266–270, 2 refs. Menasha, Wis., April 1938.

The following is substantially the author's summary: Field tests were made to compare the effectiveness of cubé powders containing either 2 per cent. rotenone and 18 per cent. total ether extractives or 5 per cent. rotenone and 12 to 14 per cent. total ether extractives in spray and dust mixtures for control of foliage pests of beans on Long Island. The powders were used in combination with sulphur sprays at the rate of 4 lb. per 100 U.S. gals., and in dust mixtures at 10 lb. in 100 lb. of complete mixture including sulphur. According to counts of numbers of larvae of *Epilachna varivestis*, Muls., and yield of pods, mixtures containing the cubé powder with 2 per cent. rotenone were as effective as those containing the cubé powder with 5 per cent. rotenone. One season's application of sulphur dusts did not affect the soil acidity as measured by the pH.

In field tests on lima beans sprayed and dusted with mixtures of copper sulphate and lime for control of plant diseases, it was observed that Bordeaux mixture by itself notably reduced the amount of feeding by *E. varivestis*. This effect was slightly enhanced by the addition of cubé powder to the mixture at the time of application or by making separate applications of cubé-clay dusts following treatment with Bordeaux mixture.

Carpenter (E. L.) & Moore (W.). **Sorption of Hydrocyanic Acid by different Species of Insects.**—*J. econ. Ent.* **31** no. 2 pp. 270-275, 3 figs. Menasha, Wis., April 1938.

Experiments on the relative amount of hydrocyanic acid taken up by adults of *Calandra* (*Sitophilus*) *oryzae*, L., *Tribolium confusum*, Duv., *Blattella germanica*, L., and *Lasioderma serricorne*, F., and mature larvae of *Tenebrio molitor*, L., were carried out with an apparatus and by a procedure that are described at length. There were marked differences in the manner in which the HCN was taken up by the various species and in the amount taken. *T. confusum* became saturated with the acid after about 40 minutes and *T. molitor* after slightly longer, while the other species continued to take up small quantities for a considerable time. *T. confusum* takes up much larger quantities of HCN than *C. oryzae* and can take up from a low concentration of vapour as much as *C. oryzae* takes from a considerably greater concentration. The species that take up smaller quantities of HCN require a greater concentration to cause death. Measurements were made to determine how the quantity taken up varies with the pressure of HCN and the equation followed over the range of pressures used in the experiments is given. The amount of HCN taken up by *T. confusum*, *C. oryzae* and *B. germanica* (the only species used in this test) was considerably greater at 20°C. [68°F.] than at 30°C. [86°F.].

Haller (H. L.) & Sullivan (W. N.). **Toxicity of Hydrogenated Pyrethrins I and II to the Housefly.**—*J. econ. Ent.* **31** no. 2 pp. 276–277, 7 refs. Menasha, Wis., April 1938.

Two pyrethrin concentrates, one in which pyrethrin I predominated and the other composed largely of pyrethrin II, were used in tests to determine the effect of catalytic hydrogenation on the toxicity of pyrethrins to the housefly, *Musca domestica*, L. Hydrogenation seriously impaired the power of both concentrates to paralyse the flies and materially reduced mortality caused by the concentrate in which pyrethrin I predominated. The mortality caused by the concentrate in which pyrethrin II predominated was very low and was not materially reduced by hydrogenation.

Goodhue (L. D.) & Cassil (C. C.). **Complexity of Calcium Arsenate as revealed by Chemical Analysis of Fractions of different Particle Size.**—*J. econ. Ent.* **31** no. 2 pp. 278–280, 1 fig., 4 refs. Menasha, Wis., April 1938.

The following is the authors' summary: A sample of calcium arsenate was separated into several fractions by an air classifier. The particle-size distribution was determined on the original sample and on three fractions, the finest and coarsest and one intermediate between these two. Analysis of these fractions showed a great variation in chemical composition, indicating that a chemical as well as a mechanical separation was accomplished. The fine particles were found to

contain more arsenically combined calcium oxide than the coarse ones and, therefore, much less water-soluble arsenic [*cf. R.A.E.*, A **25** 693].

BACK (E. A.) & COTTON (R. T.). **The Black Carpet Beetle,** *Attagenus piceus* **(Oliv.).**—*J. econ. Ent.* **31** no. 2 pp. 280–286, 23 refs. Menasha, Wis., April 1938.

Attagenus piceus, Ol., is a cosmopolitan insect and does considerably more damage than is generally supposed. The larvae spin no webs, are restless, like darkness, and in many instances feed on fabrics only long enough to cut a few threads before moving to something fresh. They are general feeders, attacking seed, grain and products of them, in addition to such animal products as wool, hair, fur, feathers, silk, horn, dried meat, dead insects, casein and dried milk. Farinaceous foods probably account for the development of more individuals than animal foods. As the larvae may make holes in cartons and other containers, they expose the contents to attack by species to which they would otherwise be inaccessible. The economic history of the Dermestid in North America, where it was apparently first found in 1806, is reviewed from the literature, and its synonymy is discussed.

Studies of the life-history were made on over 1,000 individuals, of which 565 were reared from egg to adult. In Washington, D.C., adults are usually first seen in houses during the last week of April, are most abundant during hot spells in May and early June, and become less plentiful in the middle of June. They may be present in small numbers in February and late June, and occasional individuals are sometimes seen in July and August. The adult, having shed the pupal skin, may remain quiescent within it for 2–20 days before suddenly becoming active. Adults lived for 1–35 days. Access to pollen probably increases longevity. In an attempt to determine facts relating to the daily rate of oviposition and total oviposition capacity, 1,020 adults were caught on windows, or as they emerged from cultures, and placed, without regard to sex, in groups of five in vials with pieces of mohair furniture covers and casein. Although the emergence dates of most of the beetles are unknown, it is believed that the adults were captured before oviposition was fairly under way. Records are given in a table of the eggs laid by 26 groups that were considered representative ; groups that laid no eggs or very few were excluded. In all, 3,281 eggs were laid. If it be assumed that half of the individuals were females, this represents an average of about 50 eggs each. The individuals in the 10 groups of known emergence date laid 1,327 eggs. In May and June, the egg stage lasted 6–11 days. It appeared that larvae moult 5–11 times during development, but it is believed that under adverse food and climatic conditions the number of moults could be increased to nearly 20. Many of the larvae under observation completed their development in about a year, but some for no apparent reason, and others because of adverse food and temperature conditions, require 2 or 3 years. All larvae under observation pupated during April, May or June, except three that pupated in July. It appears that when conditions are not suitable for pupation during April–June, the larvae live on till the next season, continuing to feed and moult. The pupal stage lasted 6–24 days. Ovipositing females seldom lived for more than two weeks in the laboratory.

Campbell (R. E.) & Stone (W. M.). **Flooding for the Control of Wireworms in California.**—*J. econ. Ent.* **31** no. 2 pp. 286–291, 1 ref. Menasha, Wis., April 1938.

Experiments under cage conditions in south-western California during 1929–30, involving principally *Pheletes* (*Limonius*) *californicus*, Mann., indicated the possibility of flooding being practised as an aid to the control of wireworms. In a field test in 1930, flooding gave poor results and experiments were discontinued. In 1933, however, information received from M. C. Lane indicated that the mortality caused by flooding was influenced by the prevailing soil temperatures (*R.A.E.*, A **25** 174), and a review of the data compiled from the 1929–30 experiments showed that a high mortality had been obtained when soil temperatures were relatively high. Experiments were accordingly resumed during 1933. In the first series, wireworms were placed in the soil of screen cages, 15 ins. high, which were then buried in a soil-filled tank and in a small field plot so that their tops were level with the surface of the soil. Both sets were flooded continuously from 16th to 22nd June and soil temperatures taken at depths of 4, 8 and 12 ins. Each day, one of the eight cages in each set was removed and examined. The daily temperature variation was greater at the 4-in. depth than at the deeper levels. Wireworm mortality increased each day, but 100 per cent. were killed only in the field cages on the seventh day. Mean soil temperatures were slightly higher in the field than in the laboratory (77° and 73°F., respectively, on the seventh day). On 26th June, samples of soil to a depth of 15 ins. were taken from the field around the cages, and examined for wireworms. Of the 50 found, 14 were in the top 6 ins. and all were dead, 14 were 6–9 ins. from the surface and 13 were dead, 12 were 9–12 ins. from the surface and 3 were dead, and 10 were 12–15 ins. from the surface and only 1 was dead. The mean soil temperatures at 8 and 4 ins. were 73·9° and 73·6°F., so that depth and not temperature appeared to account for the higher mortality in this case. In two additional experiments with the screen cages, with mean soil temperatures of 71·7°, 73·1° and 73·3°F. at 4, 8 and 12 ins. below the surface, respectively, the last live wireworm was recovered on the ninth and eleventh days. In the final laboratory plot experiment, with mean temperatures of 74°, 75° and 76·6°F. at the three depths, no live wireworms were recovered after the third day.

In field tests, a plot 40×600 ft., ploughed 12 ins. deep and ridged to make 48 basins, was flooded continuously from 12th to 22nd July. The mean temperatures at the surface of the soil and at depths of 4, 8 and 12 ins. during the flooding period were 72·8°, 73·9°, 73·1° and 71·2°F., respectively. The wireworm population before flooding was estimated at 12·8 per sq. ft. On 30th July, after the field had been ploughed again, the surviving population was 1·1 per sq. ft., a reduction of 91·4 per cent. A slightly smaller adjoining plot was ploughed to a depth of 8–10 ins., ridged to form basins and flooded from 18th to 31st July. The mean temperatures at the surface of the soil and at depths of 4, 8 and 12 ins. were 77·2°, 77·8°, 76·0° and 73·6°F., respectively. The wireworm population was reduced by 89·8 per cent. A young walnut orchard of 1·28 acres with a cover crop of wheat was disked and ploughed 12 ins. deep on 4th August and then ridged for flooding. The field was divided into four plots, the first flooded on 8th August, the second and third wetted several times and finally

flooded on 17th, and the fourth wetted first on 11th August, but not held under water until 17th August. All flooding was stopped on 26th August. The mean temperatures at the soil surface and at 4, 8 and 12 ins. were 72·5°, 73·0°, 72·1° and 72·6°F., respectively. The percentage reductions in the number of wireworms in the four plots were 63·6, 55·0, 52·4 and 39·0, respectively. To test the effect of soil treatment before flooding, one plot was furrowed 12 ins. deep at intervals of 12 ins., a second was furrowed 12 ins. deep at intervals of 18 ins., a third was left undisturbed, and had firm and well-packed soil, a fourth was subsoiled to a depth of 18 ins. at intervals of 12 ins., and the fifth plot was ploughed 12 ins. deep. The first two plots were held under water for 15 days from 25th August, the mean temperatures of the air and of the soil, 15 ins. below the normal surface both beneath the furrow and beneath the ridge, being 65·7° and 69·2°F. The percentage reductions in wireworm population under the ridges in the two plots were 88·2 and 92·0 and under the furrows 73·5 and 88·0. The three remaining plots were kept under water for 14 days from 29th August. Air and soil temperatures were essentially the same as in the other two plots. In these three, there was no significant difference in mortality, which ranged from 82·5 to 86·6 per cent.

In 1934, experiments were carried out in the Sacramento Valley, where temperatures are ordinarily higher. They were not, however, higher during most of the tests and erratic or poor results were obtained when they were below 70°F.

As continuous flooding is sometimes difficult, experiments on intermittent flooding were begun in south-western California on 21st May 1934. Eight cages containing soil and wireworms were buried in each of two ridged plots and the plots were flooded two days later. One plot was kept flooded and the other filled with water each morning, the surface water disappearing before evening. From the second day, a cage was taken from each plot daily, allowed to dry out for 5 days, and then sifted. The continuous and intermittent flooding gave average mortalities of 95·0 and 90·6 per cent., respectively, probably because the water in the continuously flooded plot absorbed more heat and made the soil warmer. There was no mortality in controls. The experiment was repeated from 20th June with similar results. The amount of water required for continuous flooding and the cost are discussed.

Ito (K.). **Studies on the Life History of the Pineapple Mealybug, *Pseudococcus brevipes* (Ckll.).**—*J. econ. Ent.* **31** no. 2 pp. 291–298, 3 figs., 10 refs. Menasha, Wis., April 1938.

Pseudococcus brevipes, Ckll., is at present considered the major insect pest of pineapple plants in Hawaii, chiefly because it causes pineapple wilt [*cf. R.A.E.*, A **21** 64; **25** 743, etc.]. Life-history studies were made on 250 crawlers from 10 females of the grey form, which produces green spotting when feeding [**21** 64], and 20 crawlers from each of 10 females of the pink form. The experiments lasted from early February to late June 1933. The maximum, minimum and average temperatures during this time were 83·9°, 61·3° and 74·4°F. The mealybugs were caged individually in test tubes plugged with absorbent cotton-wool and supplied with clean leaves from uninfested pineapple crowns. The crawlers were examined daily and a fresh piece of leaf was substituted after each moult. As a result of the daily

handling of the test tubes, only a relatively small proportion of the crawlers came to maturity. The females of both forms passed through three larval instars, the length of which varied greatly in different individuals. In both forms, the first was the longest and the second the shortest, though individual cases existed where either the second or the third or both lasted longer than the first. The average durations of the first, second and third instars of the pink form were 14, 9·8 and 10·3 days, respectively, and of the grey form, 14·4, 8·9 and 11·3 days.

The pink form was found to reproduce parthenogetically, no males being produced, whereas the grey form reproduced sexually. The average lengths of life of females of the pink form and paired and unpaired females of the grey form were 90, 95 and 148 days. The prelarviposition, larviposition, and postlarviposition periods of adult females of the pink form averaged 27, 25 and 5 days, respectively; the corresponding figures for the grey form after pairing were 26, 30 and 5. Apparently very little feeding is done after the prelarviposition period. The average number of crawlers produced by 64 females of the pink form was 234, and by 20 females of the grey form, 347. No unfertilised female of the grey form produced young, but pairing, resulting in reproduction, could occur at any time after maturation. Males moulted four times during development. During the second instar, the larvae became somewhat elongated and began crawling about in search of a place in which to spin their cocoons, which were constructed of white waxy filaments. The second, third and fourth moults took place within the cocoon. After the last moult the adults remained quiescent for a few days before emerging. Males usually live for only about a day after pairing, though unpaired ones lived as long as 5 days. Of one batch of 166 individuals, 65 were males, but observations indicated a great variability in the number of males produced by different females. Moreover, it has been observed that when mealybugs are transferred from one food-plant to another, or even from one environment to another, a great number of males results.

Jones (R. M.). **Toxicity of Fumigant-CO_2 Mixtures to the Red Flour Beetle.**—*J. econ. Ent.* **31** no. 2 pp. 298–309, 5 figs., 13 refs. Menasha, Wis., April 1938.

Work on the use of carbon dioxide mixed with fumigants to increase their insecticidal action is reviewed from the literature, and an account is given of tests of its effect on the toxicity to adults of *Tribolium castaneum*, Hbst., of methyl formate, ethylene oxide and methyl bromide. For each set of conditions, 8 identical tests were made, 25 beetles being used in each with two untreated lots of 25 as controls. None of these untreated beetles died while under observation. The apparatus used is shown in a figure and described in detail. The results were analysed by the method of probits [*R.A.E.*, A **22** 440; **23** 493], which is explained.

The concentrations of methyl formate, ethylene oxide and methyl bromide required to kill all of the beetles in 5 hours at 27°C. [80·6°F.] were 25·0, 17·5 and 8·75 mg. per litre, respectively, and the concentrations required to kill 50 per cent., determined by interpolation, were 17·81, 13·44 and 6·13 mg. The addition of 1, 5, 10, 20 and 40 per cent. of CO_2 to atmosphere containing 25·0 mg. methyl formate per litre

decreased the exposure necessary to kill all the beetles to $3\frac{1}{2}$, $2\frac{1}{2}$, 2, $1\frac{1}{2}$ and $\frac{3}{4}$ hours, respectively. Increasing the percentage of CO_2 to 60, 80 or 99·8 did not further decrease it. The addition of 5, 10 and 20 per cent. CO_2 to atmosphere containing 17·5 mg. ethylene oxide per litre decreased the exposure necessary to kill all the beetles to 3, $1\frac{1}{2}$ and $\frac{3}{4}$ hours, respectively. Increasing the percentage beyond 20 did not further decrease the necessary exposure, and mixtures containing 80 and 99·8 per cent. CO_2 appeared somewhat less toxic than those containing 60 per cent., but it is not certain that the differences were significant. No effect was observed when 1 per cent. CO_2 was added. The addition of 1, 5 and 10 per cent. CO_2 to atmosphere containing 8·75 mg. methyl bromide per litre decreased the exposure necessary to kill all the beetles to $4\frac{1}{2}$, 4 and 3 hours. The exposure necessary for complete mortality remained at 3 hours when the percentage of CO_2 was increased to 20 and 40 ; further increasing it to 60, 80 and 99·8 increased the exposure necessary to kill all the beetles to $3\frac{1}{2}$, 4 and $4\frac{1}{2}$ hours, respectively. Mixtures containing 20 per cent. CO_2 killed lower percentages of the beetles rather more quickly than those containing 10 or 30 per cent. The times required for the various fumigants in combination with the different percentages of CO_2 to kill 50 per cent. of the beetles, determined by interpolation, are given in a table.

ARANT (F. S.). **The relative Efficiency of certain Fluorine and Arsenic Insecticides against the Cowpea Curculio.**—*J. econ. Ent.* **31** no. 2 pp. 309–313, 2 figs., 4 refs. Menasha, Wis., April 1938.

The following is substantially the author's summary of this account of laboratory experiments carried out in Alabama during 1930–35 : A suitable method of testing the efficiency of insecticides against adults of *Chalcodermus aeneus*, Boh. (cowpea curculio) consisted in confining the weevils for 6 or 8 hours in a Petri dish containing a film of the powdered insecticide, then transferring them to food, and making regular observations to determine the percentage kill. Large numbers of the weevils were used, and tests of the various insecticides were conducted simultaneously. This method was decidedly more satisfactory than several others tried ; the weevil could not be made to ingest insecticides from leaf sandwiches or baits because the rostrum is usually inserted into the plant tissues. The percentages of net mortality at the end of the experiments caused by calcium arsenate, sodium fluosilicate, barium fluosilicate, magnesium arsenate, acid lead arsenate and cryolite were 93·8, 91·2, 90·9, 69·7, 48·9 and 14·6. Talc was an efficient diluent with three types of insecticides, *viz.*, sodium fluosilicate, derris and calcium arsenate. Preliminary experiments proved derris and pyrethrum to be relatively ineffective.

ARANT (F. S.). **Difficulties encountered in Field Dusting Experiments.** —*J. econ. Ent.* **31** no. 2 pp. 314–315, 2 refs. Menasha, Wis., April 1938.

In dusting experiments against *Chalcodermus aeneus*, Boh., on cowpeas in Alabama in 1936, infestation was significantly lower in the half of the control plots next to a treated plot than in the other half, although a buffer strip of 4 rows was left between the plots, each half of the buffer strip receiving the treatment of the plot adjacent to it.

This shows that drift of dust material considerably interferes with results obtained in such experiments. The degree of error resulting from drift tends to increase when the Latin square [*R.A.E.*, A **25** 428] or some similar arrangement of plots is used.

Burks (B. D.), Ross (H. H.) & Frison (T. H.). **An economical, portable Light for collecting nocturnal Insects.**—*J. econ. Ent.* **31** no. 2 pp. 316–318, 3 figs. Menasha, Wis., April 1938.

A mercury vapour light has many advantages over other lights for use in attracting nocturnal insects. The predominating lines in the spectra of the three commonest commercial luminous tube lights, the red or neon light, the blue or argon and mercury vapour light, and the green light, which is an argon and mercury vapour light through yellow glass, are shown in a figure. When the three lights were set up together on a warm midsummer evening and the same voltage applied to all, very few insects were attracted by the green light, a few, especially the higher Diptera, were attracted by the red, and the very great majority by the blue. The mercury vapour light operates at a low temperature, so that insects are not likely to be killed by the heat. The average dissipation by these tubes is only 3 watts per foot. The light is emitted uniformly over a relatively wide area so that the insects do not crowd over and crush each other in an attempt to reach the spot of maximum brilliance. If the mercury vapour tube is to glow, a high voltage must be applied. The general operating voltage for these tubes is approximately 800 volts per foot, although this can be varied within wide limits. Usually, 2,500 volts is satisfactory for a tube 3 or 4 ft. long. There is no difficulty in obtaining the necessary high voltage by means of a transformer when 110-volt alternating current is available. An arrangement has been devised, and is described, to enable a mercury vapour light to be operated from a 6-volt direct current source and used as a portable light to be set up anywhere in the field where collecting is desirable.

Donohoe (H. C.), Simmons (P.) & Barnes (D. F.). *Aphomia gularis* **Zeller as a Pest of Prunes.**—*J. econ. Ent.* **31** no. 2 p. 318, 1 ref. Menasha, Wis., April 1938.

Infestation of dried prunes by *Aphomia gularis*, Zell., was observed in the San José district of California in 1927. In occasional observations during the next 7 years in the San Francisco Bay area, this Pyralid or evidence of its presence and work was found in one warehouse in San José only. In February 1935, infestations were found in prunes in several warehouses in San José and one in Oakland, in which larvae were also crawling over bags of almonds. The almonds had been attacked by insects, but no larvae were observed feeding. Surveys in San José in 1936 and 1937 showed *A. gularis* to be present in prunes in every warehouse visited and serious loss to have been caused in most of them. Dried apples, pears, peaches and apricots in the same warehouses and often in adjoining bins were not attacked. The larvae are voracious feeders. Cocoons for pupation are usually spun in cracks in the bins, beneath or in the bottom of boxes and adjoining other wooden materials.

HARMAN (S. W.). *Glossonotus crataegi* **Fitch susceptible to Dormant Oil Sprays.**—*J. econ. Ent.* **31** no. 2 pp. 318–319, 2 figs. Menasha, Wis., April 1938.

A dormant application of lubricating oil emulsion, containing 6 per cent. oil, against *Tortrix* (*Archips*) *argyrospila*, Wlk., on apple in New York also gave very good control of a heavy infestation of *Glossonotus crataegi*, Fitch. One count made 11 days after the normal hatching period showed 75 per cent. kill. A spray containing 3 per cent. lubricating oil also killed a majority of the eggs of this Membracid, but 3 per cent. tar distillate appeared to have no effect.

HUTCHINS (R. E.) & LYLE (C.). **Cottonseed-hull Bran in Grasshopper Bait.**—*J. econ. Ent.* **31** no. 2 p. 319. Menasha, Wis., April 1938.

Experiments in Mississippi in July 1937 indicated that cottonseed-hull bran was as effective a carrier for poison in grasshopper bait as wheat bran. Its cost is about one-fifth of that of wheat bran. Laboratory tests against *Melanoplus differentialis*, Thos., seemed to indicate that a mixture of hull bran and wheat bran (3 : 1) was slightly more effective than hull bran alone, but in field tests against *Schistocerca americana*, Dru., there seemed to be little difference. The bait found to be most effective in the field consisted of 100 lb. cottonseed-hull bran, 5 lb. sodium arsenite or Paris green, 4 oz. amyl acetate, 2 U.S. gals. molasses and 7 U.S. gals. water.

LA DUE (J. P.). **Higher Ketones as intermediary Solvents for Derris Resinate used in Petroleum Spray Oil.**—*J. econ. Ent.* **31** no. 2 pp. 319–320. Menasha, Wis., April 1938.

Derris resinate, which appears to be toxic to several insects when incorporated with certain solvents and used with citrus spray oils, is extracted from powdered derris and cubé root when acetone, ethyl ether or other solvents are used. The solvent is distilled off, leaving the resinate as a gummy mass. In the summer of 1935, sprays of oil containing paste mixtures of derris powder with various solvents, were tested against *Saissetia oleae*, Bern., on orange in California, but gave unsatisfactory results. Acetone and ethyl ether derris extracts were also used with low percentages of spray oil, but certain difficulties were encountered, such as the resins flocculating and going out of the oil phase into the aqueous phase. During the winter of 1936–37, tests were made on a number of organic solvents from the standpoint of the solubility of the derris resinate in the solvent, the solubility of the solvent in the spray oil, the solubility or suspensibility of the mixture of derris resinate and solvent in the spray oil, the solubility of the solvent in water and the toxicity of the mixture to certain Coccids. The higher ketones appeared to give the best results from the standpoint of solubility of the derris resinate, stability of the resulting mixture and added toxicity to the spray oil. It also appeared that other compounds such as 2,2′ dichlorethyl ether, sassafras oil and the higher acetates were good solvents for derris resinate and that the solutions increased the toxicity of the spray oil to *Aonidiella aurantii*, Mask. As derris resinate is not very soluble in highly refined petroleum oil, a suspension of resins and rotenone is formed when an appreciable amount of the resinate-solvent mixture is added to the

oil. In the early part of 1937, laboratory experiments were made, using methyl isobutyl ketone, methyl-n-amyl ketone and 2,2′ dichlorethyl ether as intermediary solvents for the derris resinate and tank-mix spray oil. Derris resinate dissolved in methyl-n-amyl ketone appeared to give the best kill of *A. aurantii*. W. Ebeling has shown that methyl-n-amyl ketone incorporated in spray oil increases the toxicity of the oil to the scale and substantiated the above findings with regard to the toxicity of derris resinate to it. Moreover, he found that the solution of derris resinate in methyl-n-amyl ketone increased the toxicity of the oil to *Chrysomphalus ficus*, Ashm. (*Aonidiella aonidum*, auct.), and further tests have indicated that it does the same in the case of *Coccus pseudomagnoliarum*, Kuw., and *Saissetia oleae*. A paste formed by the addition of methyl-n-amyl ketone or 2,2′ dichlorethyl ether to the derris powder seemed to increase the efficiency of the material.

Lindgren (D. L.). **Methyl Iodide as a Fumigant.**—*J. econ. Ent.* **31** no. 2 p. 320. Menasha, Wis., April 1938.

Of many chemicals tested as fumigants in the latter half of 1937, methyl iodide (CH_3I) seemed to show the most promise. It contains approximately 89 per cent. iodine, and has a boiling point of 42·5°C. [108·5°F.]. The insects on which it was chiefly tested were resistant and non-resistant red scales [*Aonidiella aurantii*, Mask.], confused flour beetles [*Tribolium confusum*, Duv.], Coccinellids and larvae of the codling moth [*Cydia pomonella*, L.]. A few tests on *Citrus* seedlings showed that concentrations considerably above those lethal to the insects tried were not toxic to the plants. If the cost could be reduced by production of large quantities, the compound would appear to have possibilities as a fumigant.

Sherman (F.). **Massing of Convergent Ladybeetle at Summits of Mountains in South-eastern United States.**—*J. econ. Ent.* **31** no. 2 pp. 320–322, 1 fig. Menasha, Wis., April 1938.

It has long been on record that adults of *Hippodamia convergens*, Guér., gather gregariously for the winter in canyons and ravines in the mountains near the Pacific Coast of the United States. In September 1934, they were found in great numbers on the summit of the highest mountain in Michigan. An account is given of observations in the south-eastern states which showed that there they assemble in masses at the summits of high mountain peaks (not in ravines) and that the phenomenon apparently has no connection with hibernation, as observations covered all seasons except spring and masses were found on practically all occasions. Masses were present from 19th June and many did not seek shelter. It is also shown that the purpose of the assembly is apparently not to aestivate, feed, pair or die. No adequate explanation can be offered.

Smith (L. E.), Siegler (E. H.) & Munger (F.). **Organic Compounds highly toxic to Codling Moth Larvae.**—*J. econ. Ent.* **31** no. 2 pp. 322–323, 2 refs. Menasha, Wis., April 1938.

Over 200 organic compounds were tested by the apple-plug method as substitutes for arsenicals for the control of the codling moth [*Cydia*

pomonella, L.]. Most of them were difficult to wet in water and various wetting agents were used. Only 20 of the compounds, a list of which is given, kept more than 50 per cent. of the fruit free from infestation. The studies failed to show any simple relationship between the constitution of organic compounds and their toxicity to insects. Two compounds, 3,5-dinitro-*o*-cresol and *p*-nitroiodobenzene, gave 100 per cent. fruit free from infestation ; 2-thiocoumarin and phenothioxin were next in order of effectiveness, giving 97·2 and 93·5 per cent. uninfested fruit, respectively [*cf. R.A.E.*, A **25** 188].

ZIMMERMAN (E. C.). **Synonymy of the *Euscepes* Sweet-potato Weevil (Coleoptera, Curculionidae).**—*J. econ. Ent.* **31** no. 2 p. 323. Menasha, Wis., April 1938.

The author has found that *Euscepes batatae*, Waterh., is identical with *E. postfasciatus*, Fairm., and tabulates the synonymy of this species. He has already recorded this synonymy in 1936, but repeats it as the publication in which it appeared (*Occ. Pap. Bishop Mus. Honolulu* **12** no. 23) is likely to have escaped the attention of economic entomologists.

BECKER (W. B.) & TOMLINSON (W. E.). **Distribution of Elm Bark Beetles in Massachusetts.**—*J. econ. Ent.* **31** no. 2 p. 323. Menasha, Wis., April 1938.

A list is given of 2 towns in western Massachusetts and 43 in eastern Massachusetts in which the European elm bark-beetle, *Scolytus multistriatus*, Marsh., was shown to be present during a survey made in the summers of 1935, 1936 and 1937. These findings do not include those previously reported [*R.A.E.*, A **24** 33]. *Hylastes* (*Hylurgopinus*) *rufipes*, Eichh., was found in every section of the state covered by the survey. The only sections not covered were Cape Cod and the islands off the coast.

DOWDEN (P. B.). *Rogas unicolor* **(Wesm.), a Braconid Parasite of the Satin Moth.**—*J. agric. Res.* **56** no. 7 pp. 523–535, 4 figs., 12 refs. Washington, D.C., 1938.

Descriptions are given of the immature stages of *Rhogas unicolor*, Wesm., including each of the five larval instars, together with an account of its bionomics based on work carried out in Hungary and particularly in the laboratory in the United States from 1932 to 1935. This Braconid has been recorded as a parasite of *Stilpnotia salicis*, L., its only known host, in Hungary, Belgium, Holland and Germany, but does not appear to be of any importance in its control in Europe. In 1933 and 1934, about 7,000 cocoons were sent from Hungary to the United States, and about 5,000 females were liberated in New England and in Washington, but, except for a single larva dissected from a hibernating larva of *Stilpnotia* in 1934, the species has not been recovered in the field.

R. unicolor has one generation a year. The first-instar larva passes the winter within the hibernating host larva, and develops slowly in the spring, but the three next instars are completed in 3–4 days. The host appears normal until its penultimate instar, when, instead of moulting again, it becomes very sluggish, and, about the time the parasite enters the fourth instar, spins a dense white web over itself.

The parasite passes several days in the fifth instar, consuming almost the entire contents of the host larva, and then pupates in a cocoon inside its skin. About 12 days are spent in the cocoon, and adults issue about the end of June. As they cannot oviposit in larvae of *Stilpnotia* until the latter reach the second instar, they probably do not find an abundant supply of suitable host material for 2–3 weeks. Parthenogenetic reproduction normally results in female progeny, although a male occasionally appears and pairing occurs readily. A maximum of 322 eggs was obtained from a single female.

R. unicolor is attacked by a number of hyperparasites ; 14 species, a list of which is given, were reared from cocoons collected in the field at Budapest. During 1933 and 1934, *Dibrachys cavus*, Wlk., which is known also to occur in New England, parasitised more individuals than all the other 13 species together.

Ingram (J. W.) & Summers (E. M.). **Transmission of Sugarcane Mosaic by the Green Bug** (*Toxoptera graminum* **Rond.**).—*J. agric. Res.* **56** no. 7 pp. 537–540, 2 refs. Washington, D.C., 1938.

The following is taken from the authors' summary : Prior to 1936, *Aphis maidis*, Fitch, was the only known vector of sugarcane mosaic, but in that year *Carolinaia* (*Hysteroneura*) *setariae*, Thos., was shown to transmit the disease in Louisiana, and two transfers of mosaic by *Toxoptera graminum*, Rond., were reported [*R.A.E.*, A **24** 775]. *T. graminum* is widely distributed in the United States and elsewhere, and causes heavy injury to wheat and oats in the Mississippi River Valley. It has been observed on sugar-cane only in Louisiana, where it feeds on various parts of the plants that are above ground and on other grasses commonly found in and around sugar-cane fields. In a series of experiments during 1936, 30 examples of this Aphid from infected sugar-cane plants were transferred to each of 172 healthy plants, and 21 of these developed mosaic. In a parallel experiment, 40 of 124 healthy plants exposed to *Aphis maidis* developed mosaic symptoms. One out of 14 sugar-cane plants was infected by *Toxoptera* from infected crabgrass (*Digitaria sanguinalis*).

Tompkins (C. M.) & Thomas (H. R.). **A Mosaic Disease of Chinese Cabbage.**—*J. agric. Res.* **56** no. 7 pp. 541–551, 5 figs., 14 refs. Washington, D.C., 1938.

In Central California, Chinese Cabbage (*Brassica pe-tsai*) is commonly attacked during the autumn and winter by a mosaic disease, the symptoms of which are described. In experiments on the transmission of the disease by *Brevicoryne brassicae*, L., and *Myzus persicae*, Sulz., non-infective Aphids were colonised on healthy cauliflower and sugar-beet. When the population had increased sufficiently, detached leaves with Aphids were placed on diseased Chinese cabbage plants to permit of natural migration, and after the Aphids had fed for 24–48 hours, they were transferred in groups of about 20 to healthy Chinese cabbage seedlings. The controls consisted of some seedlings infested with non-infective Aphids, and others with no Aphids. The great majority of the plants infested with either *B. brassicae* or *M. persicae* became diseased in 23 days or less, and all the controls remained healthy. Transmission was also obtained by mechanical inoculation with carborundum, but not through seed. In experiments on mechanical

inoculation of other plants, characteristic symptoms were produced in some, but not all, crucifers, and local lesions in *Nicotiana glutinosa* and tobacco (*N. tabacum*). The virus proved non-transmissible to 54 species of plants representing 46 genera in 27 families.

HARTMAN (G.). **A Study of Psyllid Yellows in Wyoming.**—*Bull. Wyo. agric. Exp. Sta.* no. 220, 40 pp., 4 figs. Laramie, Wyo., May 1937. [Recd. 1938.]

This is a report of observations in Wyoming in 1935 and 1936 on *Paratrioza cockerelli*, Šulc, attacking potato and its control. All stages of the Psyllid are briefly described, and an outline of its life-history is given from the literature [*cf. R.A.E.*, A **23** 95 ; **25** 555, etc.]. The Psyllid yellows caused by the feeding of the nymphs on potato plants [*cf.* **21** 454] is responsible for very severe losses in certain seasons. The symptoms consist in curling and rolling of the leaves, followed by yellow and purple discoloration. Later the leaves become harsh, thick and leathery, and the plants remain in an abnormal state of growth for several weeks. They do not wilt, even under conditions of extreme drought. Blooming continues for an exceptionally long period. Instead of developing normally, the tubers remain small, either in masses attached close to the stem, or in long chains. If there is no infestation until the tubers are partly grown, they do not develop further and have a marked tendency to become rough and of an intensified colour. If the Psyllids are destroyed, another set of tubers is often grown. Those from infested vines have a tendency to sprout earlier than those from normal plants.

Where the Psyllids overwinter is not yet definitely known, but they were observed in appreciable numbers on native red cedars in the sandhills of western Nebraska and protected canyons in eastern Wyoming early in May 1936 ; these trees are probably the winter food-plant of the adults. The latter usually appear on wild solanaceous plants in the late spring or early summer, and migrate to potatoes later. In any one area, infestation appears almost simultaneously in nearly all the fields, especially in those planted before 1st June. In a generally infested area, however, some fields may develop few or no symptoms and give very good yields. In a general survey of the potato-producing area in 1936, it was found that potatoes planted before 1st June were heavily infested and severely affected, whereas injury to those planted after that date was comparatively light even where the Psyllids were numerous. Infestations on early and late plantings varied in the same way in 1935, when damage was much more severe. In tables showing the estimated damage in three districts from 1932 to 1936 inclusive, there appears to be a direct correlation between temperature and infestation. Injury was slight after temperatures falling to a low minimum in the winter, and rising to a high maximum during the last ten days of June and the first ten days of July ; the effect of heat is probably the more important. It appears that the eggs cannot hatch at high temperatures although the nymphs are able to complete their development. Before the budding stage, potatoes do not appear to react to the Psyllids, either because they are not susceptible, or because they are not attractive to the ovipositing females.

Detailed descriptions are given of a series of experiments on control, with a full discussion of costs. The highest average increase in production in 1935 (50·73 bushels per acre more than control plots)

was given under dry land conditions by three applications of a spray of lime-sulphur (1 gal. 32°Bé, in 40 gals. water). In the production of certified seed, two applications, one early and one during mid-season, gave the highest average increase. Where only one application was made, it was more effective in the very early stages of blooming than at any later stage of growth. Similar results were obtained with tests in three irrigated fields, two of which were planted at the beginning of June and one earlier. There was a much higher yield from the late-planted fields than from the early-planted field, but the percentage increase as a result of spraying was largest in the latter. In 1936, hot dry conditions in June and July adversely affected production, and greatly reduced the Psyllid population. Yield was again higher in the late-planted fields under both dry and irrigated conditions, but spraying appeared to increase production in only one field, and is probably not beneficial to the growth of potatoes unless Psyllid nymphs are present at the time of application.

In 1936, plots were planted at fortnightly intervals from 16th April until 25th June. Each plot was subdivided into three subplots, of which the first was sprayed twice, the second three times and the third served as a control. The plots planted in June were first sprayed on 25th July and the others on 7th July. The subsequent sprays were applied on 17th August and 7th September. Three sprays gave a greater increase in yield than two in the three earliest plots, whereas two sprays were better than three in the later ones. In the two plots planted in June, sprays were applied before any blooms had formed and the yields were lower than in the controls. Spraying at a pressure of 300–400 lb. per sq. in. gave the best results in all experiments. In varietal tests, none of the standard varieties of potatoes appeared to be completely resistant to the effect of Psyllid infestation, and it is thought that the three varieties with a certain degree of resistance are of interest only for non-commercial growers.

It is suggested that where late planting is adopted, it may be necessary to summer-fallow potato land or use some other method of conserving early spring or winter moisture.

Davis (A. C.). **Mushroom Pests and their Control.**—*Circ. U.S. Dep. Agric.* no. 457, 21 pp., 8 figs., 1 ref. Washington, D.C., April 1938.

This circular deals in a popular way with the insects and mites that attack cultivated mushrooms in the United States and their control; much of the information in it has been already noticed [*cf. R.A.E.*, A **20** 301]. The importance of proper composting is emphasised, and recommendations are given for spraying the empty mushroom house, preferably with 10 per cent. lime-sulphur, and for fumigation, before introducing the compost, with formaldehyde (using 1 U.S. qt. formalin and 1 lb. potassium permanganate per 1,000 cu. ft. air space) or with sulphur [**22** 416; **23** 470, 549], or heat sterilisation by maintaining a temperature of 120–125°F. for a few hours. Pest control by natural and artificial heating when the compost is placed in the beds, and fumigation at peak heat with sulphur [**20** 301; **22** 417] or hydrocyanic acid gas [**24** 141] is reviewed. An air temperature of 50–55°F. should be maintained after the beds have been cased to retard the development of insect and other pests.

Summary for 1937.—*Insect Pest Surv. Bull.* **17** no. 10 pp. 591–632, 8 maps, multigraph. Washington, D.C., U.S. Dep. Agric. Bur. Ent. [1938.]

Maps are given showing the distribution of the more important insect pests in the United States during 1937. Severe infestations of grasshoppers occurred in all of the infested areas, but rainfall during the summer was sufficient to produce more ample vegetation than in the preceding dry years and damage to crops was therefore less concentrated and less serious. There was a partial second generation of *Melanoplus mexicanus*, Sauss., in the west central and Rocky Mountain states, the eggs deposited by it indicating a material increase in the population for 1938. In the last few years, *Melanoplus femur-rubrum*, DeG., has increased in numbers and importance. There was a spectacular outbreak of *Dissosteira longipennis*, Thos., in areas in and converging on the panhandle of Oklahoma. Outbreaks of the mormon cricket [*Anabrus simplex*, Hald.] were reported in 1937 from 11 states, nearly 20,000,000 acres being affected. Crops in North and South Dakota were infested for the first time.

In some parts of Michigan, Indiana and Ohio, the European corn borer [*Pyrausta nubilalis*, Hb.] was as widely distributed and abundant on maize as in any other year on record. There was a general increase in the population along the Atlantic coast owing to favourable weather, particularly the absence of drought. The armyworm [*Cirphis unipuncta*, Haw.] was the outstanding insect pest in the valleys of the Mississippi, Arkansas and Ohio Rivers, causing serious damage to cereals, grasses and lucerne. Sporadic outbreaks occurred elsewhere, and in Maine serious infestation in August was reported for the first time for many years. In North Carolina, the vetch Bruchid [*Bruchus brachialis*, Fhs.] emerged from hibernation in April. The adults were as numerous as in the two previous years, but the average infestation of seed dropped from 50 to 30 per cent. Parasites reared from infested seed from Pennsylvania were *Dibrachys cavus*, Wlk., and *Habrolepoidea tarsalis*, Gir., which had not previously been recorded from this Bruchid, and *Sphaerakis* (*Bruchobius*) *mayri*, Masi, which was also found in another locality in North Carolina [*cf. R.A.E.*, A **26** 24]. *Triaspis thoracicus*, Curt. [*cf.* **26** 329] was released in several localities in Pennsylvania, and one recovery was made. *Naupactus leucoloma*, Boh., a serious pest of field crops in Florida and other states [**25** 700; **26** 131] was recorded from Louisiana, and a second species of the genus was found in two localities near the coast in Mississippi where *N. leucoloma* also occurs. The tomato pinworm [*Phthorimaea lycopersicella*, Busck] is newly recorded in Arizona, where light infestations of tomatos occurred in many districts. In Virginia, *Trialeurodes abutilonea*, Hald., was found infesting beans for the first time. Outbreaks of the beet armyworm [*Laphygma exigua*, Hb.] in the Salt River Valley in Arizona for the third consecutive year indicate that it is becoming one of the major local pests of cotton.

Pests of forest trees included the forest tent caterpillar [*Malacosoma disstria*, Hb.], outbreaks of which were severe in the north-east; and the spruce budworm, *Harmologa* (*Cacoecia*) *fumiferana*, Clem., recorded, probably for the first time, causing excessive damage to *Pinus ponderosa*, and the Saturniid, *Coloradia pandora*, Blake, on lodgepole pine [*Pinus contorta*], both in central Colorado. Pines in New Jersey and Ohio were infested by *Diprion* (*Neodiprion*) *sertifer*, Geoff., which

was apparently introduced from Europe into New Jersey in 1925, but has only recently been identified. White fir [*Abies*] was attacked by *Hemerocampa oslari*, Barnes, in central California, and by *Ellopia fiscellaria lugubrosa*, Hulst, in Idaho and Montana; and Douglas fir [*Pseudotsuga taxifolia*] by *Hemerocampa pseudotsugata*, McDunn., in Idaho.

MARCHIONATTO (J. B.). **Argentine Republic: New Studies on the "Lepra Explosiva" of the Orange.**—*Int. Bull. Plant Prot.* **9** no. 8 pp. 173 M–175 M. Rome, August 1935. **Transmission of the "Lepra Explosiva" of the Orange by Mites.**—*Op. cit.* **12** no. 6 pp. 121 M–122 M. June 1938.

In the first paper, an account is given of a serious disease of orange in Argentina, known as lepra explosiva. It was first attributed to a fungus, but was subsequently considered to be due to a virus, as it has been artificially reproduced by inoculation of sap and no micro-organism concerned in its production has been isolated from diseased plants.

In the second paper, the author reports on experiments on the transmission of the disease by mites that were carried out by M. J. Frezzi in north-eastern Argentina. About 200 mites of the genus *Tenuipalpus*, selected from freshly injured plants, were transferred to healthy potted sweet-orange plants, the exposed parts of which had been disinfected with alcohol. Typical injury was observed on the leaves, twigs, petioles and spines after 2½ months, and became pronounced after 4 months. Counts of 37 and 40 lesions per plant were recorded after 3 months. Many leaves which showed 4 or 5 lesions in a short time acquired a yellow colour, and subsequently dropped.

FAWCETT (G. L.). **La corcova del tabaco y su presencia en las plantaciones de tomates.** [The "Corcova" Disease of Tobacco and its Presence in Tomato Plantations.]—*Circ. Estac. exp. agric. Tucumán* no. 60, 4 pp. Tucumán, 1938.

Descriptions are given of the symptoms in tobacco and tomato at Tucumán, Argentina, of a virus disease known as "corcova of tobacco." In both plants, the leaves turn yellow or bronze, and fall, and the plants often die. Investigations in 1937 showed that the virus was transmitted by *Frankliniella paucispinosa*, Moult., the adult and larva of which are briefly described. The larvae transmitted the virus from diseased to healthy plants, characteristic symptoms appearing within a week when the temperature was 25–30°C. [77–86°F.], and from diseased tomato to tobacco. Transmission by adults sometimes occurred.

The larvae can be controlled with a spray of nicotine sulphate (1 : 1,000), applied when the plants are quite young, preferably when there are only two leaves. Frequent applications are necessary. A lead arsenate spray can also be used, and controls other pests. Tobacco transplanted early (September or early October) and tomatos planted in May suffer less from the disease.

Blanchard (E. E.). **Un nuevo enemigo de la oruga del duraznero.** [A new Enemy of the Peach Moth.]—*Rev. chil. Hist. nat.* **41** pp. 178–180, 1 fig. Santiago, Chile, 1937. [Recd. June 1938.]

A description is given of the female of the Pteromalid, *Trichomalus trujilloi*, sp. n., which parasitises the hibernating larvae of *Cydia* (*Laspeyresia*) *molesta*, Busck, in Uruguay.

Insect Pests and their Control.—*Agric. Gaz. N.S.W.* **49** pt. 5 pp. 249–252, 5 figs. Sydney, 1st May 1938.

This part of a series on the insect pests in New South Wales [*cf. R.A.E.*, A **26** 404, etc.] includes brief notes on *Leptocneria* (*Lymantria*) *reducta*, Wlk., infesting white cedar [*Melia azedarach*]. The adults are common in the Sydney district in late summer. During the day the larvae usually occur massed together on the trunks of trees, at or near the base ; at night they feed on the leaves, sometimes causing complete defoliation. Pupation takes place in a flimsy open cocoon at the base of the tree or beneath débris. Larvae on the trunks of the trees may be swept up and destroyed, or a contact spray, such as pyrethrum-kerosene or a concentrated kerosene emulsion, may be used against them. Early in the season, effective control may be obtained by spraying the foliage with 1½ lb. lead arsenate in 40 gals. water.

Noble (N. S.). **The Greenhouse White Fly. Control by the Parasite** *Encarsia formosa*.—*Agric. Gaz. N.S.W.* **49** pt. 5 pp. 253–255, 287, 3 figs., 2 refs. Sydney, 1st May 1938.

This paper summarises work in Australia on the control of the greenhouse whitefly [*Trialeurodes vaporariorum*, Westw.] by its parasite, *Encarsia formosa*, Gah., which was introduced from New Zealand in 1934 [*R.A.E.*, A **24** 378]. The Aphelinid has become established both in greenhouses and the field, and is exercising effective control in many districts [**25** 677, etc.].

Evans (J. W.). **The Pea Mite and the Red-legged Earth Mite.**—*Tasm. J. Agric.* **9** no. 2 pp. 72–75, 2 figs., 4 refs. Hobart, May 1938.

Penthaleus major, Dugès, which has been recorded as a pest of oats in New South Wales [*R.A.E.*, A **9** 219] and as preferring grasses to broad-leaved plants in South Australia [**23** 150], sometimes attacks winter peas severely in southern Tasmania, and in one case, on small plots, was observed to destroy clover completely and to affect grass seriously. The eggs remain on the soil surface in summer, as it is never moist enough for a sufficient period for them to hatch. The young mites appear during April and become adult in 6–8 weeks. During the active period, which continues until October or November, several generations are produced and eggs are laid on leaves. Damage to peas is most severe in June and July.

The bionomics of *Halotydeus destructor*, Tucker, are similar ; its greater importance as a pest [*cf.* **22** 252] is probably due to its greater powers of reproduction. It was probably introduced into Western Australia from South Africa, and now also occurs in South Australia, Victoria and New South Wales [*cf.* **22** 265] ; although present on both King and Flinders Islands, it is not yet known to be established on the Tasmanian mainland. It feeds on a wide variety of garden plants and market crops, and on clover, damaging young plants

particularly, and is abundant on light sandy soil. Both mites may be controlled by cultural methods and dusts [**26** 85] or by sprays of lime-sulphur or nicotine sulphate [**25** 654], which, however, kill only those individuals that come into contact with them. Derris or pyrethrum dusts are recommended for garden plants.

Key (K. H. L.). **The Regional and Seasonal Incidence of Grasshopper Plagues in Australia.**—*Bull. Coun. sci. industr. Res. Aust.* no. 117, 87 pp., 14 figs., 3 maps, 65 refs. Melbourne, 1938.

In this paper, all available information on locust outbreaks in Australia is collated and analysed. The two species of major economic importance are *Chortoicetes terminifera*, Wlk., and *Austroicetes cruciata*, Sauss. (*jungi*, Branc.). In south-eastern Australia records of outbreaks, which are mostly of *C. terminifera*, go back to 1844 ; the breeding and migrations during the very extensive outbreak of 1933–35 are described in great detail and illustrated by a series of maps. In western Australia, the records date back to 1916 and mostly concern *A. cruciata*, severe infestations of which occurred in 1922–26 and 1936–37.

During outbreak years, *C. terminifera* usually has three complete generations a year, with sometimes a partial fourth, in its main infestation areas ; they hatch in September, November, January and April, respectively. No periodicity could be discerned in the incidence of outbreaks, and no regularity in their duration. The distribution and invasion areas are discussed ; tropical and humid conditions appear to be unfavourable, for this species is rare in the tropics and in the eastern coastal regions ; it is also absent from forests and close pasture. The infestation area extends through New South Wales, southern Queensland, the north-west of Victoria and the south-east of South Australia, but in all cases the coastal areas remain free. Swarms occasionally occur in northern Queensland and the south-west of Western Australia. Between 1890 and 1937, swarms occurred most frequently in New South Wales. Within the invasion areas, mountainous or timbered country remains comparatively free, and the routes of easterly penetration of swarms have a definite relation to the distribution of timber and mountain barriers. A map is given of the known and suspected outbreak centres, which stretch in a discontinuous belt from south to north across east-central New South Wales and into southern Queensland. Migration from outbreak centres occurs when the population within them reaches a certain critical density. In the case of *C. terminifera*, there is no evidence that a concentration of the population is caused by a restriction of the normal habitat [*cf. R.A.E.*, A **24** 231, 234], but synchronisation of hatching as a result of a sudden onset of rains is probably a very important factor. In this species, aggregation into migrating swarms appears to take place during the short flights immediately following the last moult. During outbreak years migration occurs in January and March, the migrants representing the second and third generations of the season. Before the end of the second season, there usually occurs a pronounced reduction in the numbers of locusts, particularly in the outbreak centres and central part of the infestation area, owing to parasites and predators. In the third season, the population dwindles away, except in the outbreak centres, where the nucleus of a new outbreak may already be forming.

Austroicetes cruciata has only one generation a year, hatching in July–August in Western Australia and in September in the south-east. The distribution area is apparently confined to the southern half of the continent, lying mostly within 10- and 20-inch isohyets; the invasion area falls into 3 sections, *viz.*, south-central New South Wales and north-western Victoria, south-central South Australia, and the eastern wheat belt of Western Australia. A study of the frequency of infestations in the latter region showed that they were most frequent in areas with an annual rainfall of 11–14 ins. In South Australia, the invasion area lies wholly within zones with an annual rainfall of 10–15 ins.; and in New South Wales, the swarms occur only under exceptional climatic conditions, such as in 1898–1902, during which the rainfall was below normal and ranged between 10 and 17 ins. per year.

The distribution and invasion areas of *Gastrimargus musicus*, F., and *Phaulacridium vittatum*, Sjöst., are discussed and illustrated by maps. The former has a coastal and subcoastal distribution throughout Australia and Tasmania, and frequently swarms north of latitude 26°S., damaging sugar-cane and pasture. There are two generations a year, hatching in September–November and in March. The brachypterous *P. vittatum* has a coastal and subcoastal distribution in the southern half of the continent and Tasmania, mainly in the area where the annual rainfall is over 20 ins.; outbreaks of this species occurred in south-eastern Australia in 1934–37. Maps are included of the known distribution areas of *Oedaleus australis*, Sauss., which has been reported as swarming and damaging pasture in eastern Australia, and of *Locusta migratoria*, L., which has a coastal distribution, and of which swarms have been recorded. *Austracris guttulosa*, Wlk., swarms occasionally in the northern half of the continent. *Brachyexarna lobipennis*, Sjöst., and *Praxibulus laminatus*, Stål, in the east, and species of *Urnisa* and *Peakesia* in Western Australia, have been reported as injurious.

Andrewartha (H. G.), Davidson (J.), and Swan (D. C.). **The "Grasshopper" Problem in South Australia.**—*J. Dep. Agric. S. Aust.* **41** no. 6 pp. 565–571, 5 figs. Adelaide, January 1938.

In South Australia, both *Chortoicetes terminifera*, Wlk. (black tipped locust) and *Austroicetes cruciata*, Sauss. (plague grasshopper) develop into outbreak numbers and are of great economic importance. Field investigations are carried out by means of survey tours on a motor truck, during which a search for locusts is made at intervals of every 10 miles along the route. Maps based on such tours are given to illustrate the distribution of the two species in South Australia in 1935, 1936 and 1937. Data on the ecology, distribution and last outbreak of *Chortoicetes* have been noticed elsewhere [*R.A.E.*, A **23** 129; **24** 69; **25** 348]. The rainfall in the zone occupied by the main distribution area of *Austroicetes* is more reliable than in that of *Chortoicetes*, and its outbreaks, which are closely associated with the rainfall of particular seasons, are more frequent [*cf.* **26** 169].

Pemberton (C. E.). **Susceptibility of Unhusked Rice (Paddy) versus Polished Rice to Rice Weevil Attack.**—*Hawaii. Plant. Rec.* **42** no. 2 p. 103. Honolulu, 1938.

In investigations in Hawaii on the resistance of rice to infestation by *Calandra oryzae*, L., 100 weevils were placed at the end of September 1937

in each of 3 jars containing, respectively, 3 quarts polished rice, 4 quarts husked but unpolished rice, and 5 quarts unhusked rice. When the jars were fumigated 107 days later, the percentages of sound grains were 0, 76 and 97·5, and the numbers of weevils per quart of grain were 14,828, 1,488 and 176, respectively.

PEMBERTON (C. E.). **Occurrence of the Grass Mealybug** *Antonina indica* **Green on Sugar Cane.**—*Hawaii. Plant. Rec.* **42** no. 2 pp. 107–108, 1 fig. Honolulu, 1938.

Antonina indica, Green, which occurs in Hawaii chiefly on the nodes of *Cynodon dactylon*, has been found there in two, or possibly three, instances on sugar-cane growing in pots. The two definite records were in October 1932 when it was observed on aerial roots of Lahaina sugar-cane and in January 1938 when it occurred in considerable numbers on the nodes of plants of this variety. It is not likely to become a pest of sugar-cane in the Hawaiian Islands, where it has been known to be present for over 30 years and is controlled fairly effectively by parasites.

MARTIN (J. P.). **Stem Galls of Sugar Cane induced with an Insect Extract.**—*Hawaii. Plant. Rec.* **42** no. 2 pp. 129–134, 5 figs., 12 refs. Honolulu, 1938.

Stem galls of sugar-cane have been reported from various countries and have occurred in Hawaii since 1910, but were of little significance there until they appeared in large numbers on seedlings in 1925. They are not very important on commercial canes, most varieties of which are affected. Healthy canes failed to produce galls when plant juices extracted from galls were injected into them, when placed in contact with galled varieties, or when directly inoculated with diseased tissue, and isolation studies failed to indicate any causal organism. *Tarsonemus spinipes*, Hirst, is usually present on stalks showing galls, and is often close to the growing point. Indications of a relationship between feeding by this mite and gall-formation were observed in 1932 and, on certain varieties that normally produced galls, none appeared when repeated applications of sulphur were made to the cane tops.

As *Draeculacephala mollipes*, Say, was fairly common in 1936 on sugar-cane at one substation, the possible connection of this Jassid with gall-formation was investigated. In an experiment in May, 2 out of 4 stalks of one variety and 3 out of 4 of another showed galls on the internodes 7 weeks after inoculation with an extract prepared by macerating 40–45 of the Jassids in water. The controls remained healthy. The same proportions of stalks showed galls 14 weeks after inoculation in July with an extract from 35 Jassids, the injury first appearing after 8 weeks. These results were confirmed on one of the varieties in October 1937, when stalk tissue of different ages was inoculated. Injury first appeared after 6 weeks, and 9 out of 21 stalks showed galls 12 weeks after inoculation slightly below the growing point or in stem tissue capable of further growth. Long thin galls developed at the base of the leaf-sheath on 3 stalks, but none occurred on the leaf blade. Galls had been observed on the leaf-sheath under

field conditions in 1927. Bunch top was noted on 2 stalks, and on 1 of 5 control stalks that had been inoculated with distilled water ; another of the latter showed indefinite symptoms of galls. This appears to be the first example of the development of stem galls on sugar-cane stalks following artificial inoculations.

OSBORN (H. T.). **The Introduction into Hawaii from Mexico of Insect Parasites to control Armyworms (1923–1924).**—*Hawaii. Plant. Rec.* **42** no. 2 pp. 147–152, 6 figs., 3 refs. Honolulu, 1938.

An account is given of the author's search for parasites of army-worms in Mexico and their introduction into the Hawaiian Islands. The species that became established there were *Euplectrus platyhypenae*, How. [*cf. R.A.E.*, A **12** 412] and *Archytas cirphis*, Curr. [**16** 108, 109]. *Apanteles militaris*, Walsh, which may be more specialised in its host relationship than *Euplectrus*, and a small Tachinid with a short life-cycle, up to 6 of which complete their development in a single larva of *Cirphis* sp., were also introduced, but failed to become established, as also did *Calosoma semilaeve*, Lec., a shipment of which was made from Mexico in 1923, and other predacious Carabids that have been imported from California. It is difficult to ascertain the value of the two introduced parasites, as there have always been wide fluctuations in the abundance of army-worms in Hawaii. Moreover, two efficient parasites of army-worms, *Telenomus nawai*, Ashm., and *Hyposoter exiguae*, Vier., have recently appeared naturally in the islands.

OSBORN (H. T.). **Introduction into the Hawaiian Islands of Mexican Enemies of the Avocado Mealybug.**—*Hawaii. Plant. Rec.* **42** no. 2 pp. 153–158, 6 figs., 1 ref. Honolulu, 1938.

Details are given of the collection in Mexico and shipment to Hawaii in March and April 1922 of insects found attacking *Pseudococcus nipae*, Mask., on guava and avocado. Eight shipments of Coccinellid larvae ready to pupate were made, comprising 80 larvae of *Hyperaspis* sp., 720 of *H. silvestrii*, Weise, and 80 of *Curinus coeruleus*, Muls. Of these three species 27, 289 and 37 adults, respectively, arrived alive, and the last two subsequently became established and widespread in Hawaii, but their value could not be ascertained owing to the control of *P. nipae* by *Pseudaphycus utilis*, Timberlake [*cf. R.A.E.*, A **11** 527].

Shipments of parasitised mealybugs were made in April, and 23 females and 26 males of *P. utilis* were reared from one of them and liberated directly in infestations of *Pseudococcus nipae*. The success of this Encyrtid was remarkable, as regards both the rapidity of its spread and the complete control of the host, amounting to practical eradication, effected by it. In 1932, *P. nipae* could be found everywhere on avocado, fig, mulberry and other trees, but all its food-plants were free from infestation on Oahu (where *Pseudaphycus* was first liberated) in November 1924 and on Maui and Hawaii soon afterwards. No re-infestation has occurred.

Several hundred adults of a Scelionid, *Allotropa* sp., and smaller numbers of two Encyrtids of the genus *Gyranusa* were reared in Honolulu from material sent from Mexico and released, but did not become established. It is possible that the mealybugs from which they were obtained were not *P. nipae*.

Berger (E. W.). **The Mango Shield Scale, its Fungus Parasite and Control.**—*Florida Ent.* **21** no. 1 pp. 1–4, 2 figs. Gainesville, Fla, March 1938.

Infestation of mango by *Coccus mangiferae*, Green, which is widespread in Florida, was particularly severe in June 1937 on an island off the west coast, though some of the scales were attacked by *Cephalosporium lecanii*. An inspection of the trees in late October showed that the fungus had achieved a fair measure of control, but heavily infested trees were black with sooty mould, and some showed signs of injury. Immature scales were observed migrating to new growth. A spray of oil emulsion or soap solution applied to both surfaces of the leaves was recommended to kill the scales and loosen the mould.

Hill (S. O.). **Important Pecan Insects of northern Florida.**—*Florida Ent.* **21** no. 1 pp. 9–13. Gainesville, Fla, March 1938.

Brief notes are given on the bionomics of insect pests of pecan in northern Florida, the most important of which are *Acrobasis caryae*, Grote [*R.A.E.*, A **15** 70], *A. juglandis*, LeB., *Enarmonia* (*Laspeyresia*) *caryana*, Fitch [**18** 548 ; **22** 27], and *Melanocallis caryaefoliae*, Davis. *A. juglandis*, which has one generation annually, causes considerable damage in some years. The larvae overwinter in hibernacula at the base of buds on twigs of the last season's growth and become active when the buds begin to swell. When they are very numerous, they may destroy the foliage as fast as it appears. In many cases, infestation of the terminal and lateral buds, on which the nuts are produced, prevents the setting of the crop. Damage is seldom serious later in the summer, when the foliage is well developed. *Melanocallis caryaefoliae*, which attacks the leaves, is only occasionally injurious, but in severe infestations may cause complete defoliation. It becomes abundant only in the second half of the summer.

Less important insects that rarely occur in outbreak numbers include *Nezara viridula*, L., *Euschistus euschistoides*, Voll., *Leptoglossus phyllopus*, L., and *L. oppositus*, Say, all of which feed on the nuts, puncturing them and causing black pit and kernel spot [**21** 292] ; and *Datana integerrima*, G. & R., *Hyphantria cunea*, Dru., *Oncideres cingulatus*, Say, *Gretchena bolliana*, Sling., and *Acrobasis caryivorella*, Rag. A species of *Xyleborus* and *Chrysobothris femorata*, Ol., attack young nursery trees, but usually only those that are unhealthy. *Coleophora caryaefoliella*, Clem., occurs in all the pecan-growing areas of Florida, but is only considered as a pest in the western districts. *Chrysomphalus obscurus*, Comst., and *Curculio caryae*, Horn, have very rarely been recorded in Florida, although they are very destructive in other pecan-growing states.

Kadow (K. J.) & Anderson (H. W.). **The Role of Zinc Sulfate in Peach Sprays.**—*Bull. Ill. agric. Exp. Sta.* no. 414 pp. 207–255, 9 figs., 75 refs. Urbana, Ill., April 1935. **Further Studies on Zinc Sulfate in Peach Sprays, with limited Tests in Apple Sprays.**—*Op. cit.* no. 424 pp. 131–144, 22 refs. Urbana, Ill., July 1936.

These two papers deal chiefly with a seven years' study of zinc sulphate as an ingredient in sprays for peach in Illinois ; the following is taken from a summary of the main conclusions given in the second : Zinc sulphate should always be added to the spray of acid lead arsenate

and lime used for peaches in Illinois, as it is particularly valuable in reducing spray injury. Hydrated lime, when added to acid lead arsenate to prevent the formation of water-soluble arsenic, is quickly converted into the carbonate under conditions of high temperature and humidity, mainly by the carbon dioxide of the air, and then actually increases this formation. Small amounts of zinc sulphate appear to be as effective as larger amounts in reducing water-soluble arsenic in peach sprays consisting of acid lead arsenate with hydrated lime or calcium carbonate. Under average conditions, spray injury is effectively reduced by using 1 lb. zinc sulphate in 100 U.S. gals. water with 3 lb. acid lead arsenate and 3 lb. lime.

When tested in sprays for apple trees, zinc sulphate at concentrations of 8 lb. to 100 U.S. gals. water with acid lead arsenate and lime resulted in severe russet, but the effect of small amounts was not determined. It appeared scarcely to alter the insecticidal value of lead arsenate and lime (to which oil was added) for the control of codling moth [*Cydia pomonella*, L.].

Zinc sulphate was not effective against fungi on peach and apple, or bacterial spot (*Phytomonas pruni*) on peach, and was not observed to have a stimulating effect on peach in Illinois.

Rehn (J. A. G.) & Rehn (J. W. H.). **The Post-oak Locust** (*Dendrotettix quercus*) **in the eastern United States, with Notes on Macropterism in the Species (Orthoptera : Acrididae).**—*Trans. Amer. ent. Soc.* **64** no. 1 pp. 79–95, 2 pls., 11 refs. Philadelphia, March 1938.

A brief survey is given of outbreaks of *Dendrotettix quercus*, Pack., in the eastern United States, and one observed in 1936 is described in some detail. It occurred over an area of about 1,700 acres in the Lebanon State Forest, New Jersey. Oak shrubs and even oak trees forty feet high were completely defoliated. Pines were not damaged, but huckleberry foliage was eaten. Both the brachypterous and macropterous forms of the Acridid were present, with rare intermediate ones. The percentage of macropterous forms in the centre of the outbreak area become reduced in the course of a few days, suggesting that they might have migrated. Towards the end of the season, adults were heavily infested by Dipterous larvae, and *Sarcophaga atlanis*, Aldr., was bred from one of them.

Mallis (A.). **The California Fire Ant and its Control.**—*Pan-Pacif. Ent.* **14** no. 2 pp. 87–91. San Francisco, Calif., April 1938.

Solenopsis geminata var. *maniosa*, Wheeler, is a troublesome pest in California. It attacks man and animals, invades houses, feeds on fruits, vegetables and stored food-stuffs of various kinds, damages linen and silk, fosters Aphids and Coccids, and sometimes causes direct injury to plants by attacking roots, leaves and cambium. The workers are active throughout the year, but swarming occurs most commonly from May to September. The nests are found in lawns or under various kinds of shelter and very frequently in walls in the vicinity of the kitchen.

Syrups and other baits poisoned with an arsenical rarely control this ant. Those poisoned with thallium sulphate are much more efficient, but the private use of the latter is prohibited in California. Good control has been obtained by pouring a few drops of carbon

bisulphide, preferably mixed with 75 per cent. carbon tetrachloride to reduce the risk of explosion, in holes in and near the nests 2 or 3 times over a fortnight. If the ants nest under a house, they may be eliminated for at least a year by forcing lime (slaked or unslaked) through the ventilators beneath the house by means of a bellows-type duster so that it is evenly distributed.

Graves (H. W.). **A Hawaiian Elaterid Beetle introduced into California.** —*Pan-Pacif. Ent.* **14** no. 2 p. 91. San Francisco, Calif., April 1938.

The Hawaiian sugar-cane wireworm, *Conoderus* (*Monocrepidius*) *exsul*, Sharp, has become established in Alameda, western California. An adult was collected on a lawn in July 1937, and larvae were feeding on the roots of grass in February and March 1938.

Essig (E. O.). **The Ornate Aphid, new to America.**—*Pan-Pacif. Ent.* **14** no. 2 pp. 92–95, 1 fig., 1 ref. San Francisco, Calif., April 1938.

An account is given of the discovery of *Myzus ornatus*, Laing, in 1936 and 1937 on 8 species of plants in western California, 5 in Belgium and 12 in widely varying localities in England. This Aphid, which was originally described from violets in England [*R.A.E.*, A **20** 257], is considered to have been introduced into all the above countries, as it could not otherwise have escaped detection so long. Descriptions are given of the winged and wingless viviparous females.

Jones (T. H.), Webber (R. T.) & Dowden (P. B.). **Effectiveness of imported Insect Enemies of the Satin Moth.**—*Circ. U.S. Dep. Agric.* no. 459, 24 pp., 6 refs., 4 figs., Washington, D.C., April 1938.

The following is largely the authors' summary of this review of work carried out in Austria, Hungary and the United States on the parasites of *Stilpnotia salicis*, L.: *S. salicis* is common throughout Europe and at times severely defoliates poplar and willow. It was first discovered in the United States in 1920 and now occurs over almost half the total area of New England and nearly all of Washington west of the Cascade Range, and in north-western Oregon. In both New England and Washington, it was first observed as a pest of *Populus*, particularly species introduced and planted for shade or ornamental purposes. Later, species of *Populus* in natural growths and species of *Salix* were attacked.

Soon after the moth was first discovered in New England, it was found that it was being attacked by certain insects that had previously been imported against the gipsy and brown-tail moths [*Lymantria dispar*, L., and *Nygmia phaeorrhoea*, Don.]. Observations have shown that two of these, *Compsilura concinnata*, Mg., and *Eupteromalus nidulans* (Forst.) Thoms., destroy large numbers of the larvae of *S. salicis*. It is probable that *C. concinnata* is of more importance as a parasite of *S. salicis* where *L. dispar* is not present in appreciable numbers than where the latter is numerous. Native insect enemies have not been found to be important in controlling *S. salicis* in New England or Washington.

From 1927 to 1934, inclusive, seven species of Hymenoptera and Diptera parasitic on *S. salicis* in Europe were imported and liberated in

infested areas in New England, but only one, *Apanteles solitarius*, Ratz., is known to have become established as an effective agent in reducing infestations there [*cf. R.A.E.*, A **23** 619]. In New England, the *Stilpnotia* population is reduced by unusually low winter temperatures, spraying, fungi and birds as well as by the three effective introduced parasites. Observations suggest that infestation reached a peak in 1930 or 1931, and that defoliation, on the whole, was much less severe from 1932 to 1934, inclusive. It is significant that *A. solitarius* was first recovered in promising numbers in 1930. It appears that its addition as a control factor was sufficient to reduce, at least temporarily, the numbers of its host to such a degree that it was less injurious from 1932 to 1934.

In Washington, ten species of insect enemies of European origin were liberated in 1929–34. Some of these were collected in New England, where they were already established, while others came directly from Europe. Four, *C. concinnata*, *Meteorus versicolor*, Wesm., *E. nidulans*, and *A. solitarius* have become established. *A. solitarius* rapidly increased and spread, and dissections of *Stilpnotia* larvae collected at various points in the state indicate that *M. versicolor* and *C. concinnata* have become of considerable importance as parasites at or near the centres of liberation. This is of particular interest in connection with *M. versicolor*, since it is not known to have gained a foothold in New England. Observations show that there was a general decrease in the *Stilpnotia* population in Washington in 1935, coinciding with a conspicuous abundance of *A. solitarius*.

Everly (R. T.). **Spiders and Insects found associated with Sweet Corn with Notes on the Food and Habits of some Species. I. Arachnida and Coleoptera.**—*Ohio J. Sci.* **38** no. 3 pp. 136–148, 1 fig. Columbus, Ohio, May 1938.

A list is given of some spiders and a large number of Coleoptera found associated at Toledo, Ohio, in a field of maize used for research on *Pyrausta nubilalis*, Hb. It shows the numbers, dates of capture and food-habits of a few of them.

Kemp (H. J.), Vigor (S. H.) & King (K. M.). **Mechanical Spreaders for Grasshopper Bait.**—*Publ. Dep. Agric. Canada* no. 606, 19 pp., 14 figs. Ottawa, March 1938.

Although scattering by hand is an efficient method of applying grasshopper baits, mechanical bait spreaders afford marked advantages for general poisoning of large areas and where repeated poisoning is necessary. They reduce the time and labour required to protect a large acreage and permit a thinner and more uniform application of the bait. Five different types of bait spreaders are described, with full details and diagrams of their construction, mainly from parts from other agricultural machines and tools usually found on farms in Canada.

Volkonsky (M.). **Une mutation mélanique de** *Schistocerca gregaria* **Forsk. obtenue en élevage.**—*C. R. Soc. Biol.* **127** pp. 254–255. Paris, 1938.

The coloration of a stock of dark-coloured individuals of *Schistocerca gregaria*, Forsk., is described. The melanism, which appeared to be

due to breeding the parent locusts under comparatively cold conditions [*cf. R.A.E.*, A **24** 738], was hereditary, and behaved like a recessive Mendelian character.

LEPESME (P.). **Recherches sur une aspergillose des Acridiens.**—*Bull. Soc. Hist. nat. Afr. N.* **29** pp. 372–384, 2 pls., 2 figs., 17 refs. Algiers, 1938.

The infection of *Schistocerca gregaria*, Forsk., by *Bacillus prodigiosus* and *B. pyocyaneus* [*R.A.E.*, A **25** 657] was found to be secondary to infestation by the fungus, *Aspergillus flavus*, which is normally a saprophyte, but becomes parasitic under certain conditions (a temperature between 30 and 45°C. [86–113°F.] and high humidity). The fungus and the internal and external signs of infestation are described ; infestation can be produced by introducing the spores into thoracic stigmata, but not by applying a culture to external coverings or through the alimentary canal, and is characterised by the appearance of ochreous patches on the thoracic sternites and pleurites and paralysis. Successive passages through the locusts increased the virulence of this fungus, which was also found parasitising *Locusta migratoria*, L.

SHAFIK (M.). **Control of the Longhorn Beetle** *Stromatium fulvum* **(Villers) on valuable Furniture in Egypt.**—*Bull. Minist. Agric. Egypt* no. 182, 9 pp., 8 refs., 4 pls. Cairo, 1938. Price, *Mill.* 25.

Records are given of the occurrence in Egypt of *Stromatium fulvum*, Villers, a Cerambycid that infests seasoned hard-wood timbers, with a list of control methods, suggested in the literature, against wood-boring insects. In 1932, a severe infestation was discovered in furniture and other woodwork in the Ras-El-Tin Palace, and control measures were undertaken in the following year. When infested pieces of wood were treated with different fumigants under experimental conditions, the best results (100 per cent. mortality of the larvae in 48 hours) were obtained with hydrocyanic acid gas generated from Zyklon, at a concentration of 10·3 oz. per 1,000 cu. ft., a humidity of 76 per cent., and a temperature above 22°C. [71·6°F.]. For the practical work, the concentration used was 12 oz. HCN per 1,000 cu. ft. with an exposure of 48 hours. In treating the infested wooden floor of a room, the doors and windows were made airtight and electric fans were turned on for 10 minutes after the Zyklon had been placed on the floor. Two tables that could not be moved from a hall were fumigated under airtight covers. All other furniture in the infested area was removed and treated in a fumigation chamber. The temperature varied from 16·7 to 28·5°C. [62·1–83·3°F.], and the relative humidity was 78·2 per cent. The holes in two infested doors and their frames were filled by injecting, 3 times at intervals of 2–5 minutes, a saturated solution of paradichlorobenzene in carbon bisulphide. They were then blocked with a special paste prepared from fine shavings mixed with glue and the surface polished. No further infestation was reported from the Palace during the 3 years following treatment.

Attempts to rear *S. fulvum* under laboratory conditions were unsuccessful. From 1933 to 1936, intermittent observations were made on the stages present in infested wood. Larvae, pupae and adults

were all found in July 1936. It is thought that the larval period lasts for at least 2 years [*cf. R.A.E.*, A **18** 189]. In Alexandria, in the autumn of 1934, larvae were found to be parasitised by the Bethylid, *Sclerodermus domesticus*, Latr.

Bigi (F.) & Ciferri (R.). **Segnalazione della " Rosetta " dell' Arachide nella Somalia Italiana.** [The Record of Rosette Disease of Ground-Nuts in Italian Somaliland.]—*Agric. colon.* **32** no. 3 pp. 104–113, 1 fig., 15 refs. Florence, March 1938.

Rosette disease of ground-nuts [*Arachis hypogaea*] is recorded from Italian Somaliland, where *Aphis laburni*, Kalt., the vector in other parts of Africa, is known to occur. The disease appears irregularly and does not seem to be of economic importance.

Melville (A. R.). **Kenya Coffee Mealy Bug Research.**—*E. Afr. agric. J.* **3** no. 6 pp. 411–422, 2 figs., 5 refs. Nairobi, May 1938.

Pseudococcus kenyae, Le Pelley, has not ceased to spread on coffee in the Central Province of Kenya [*cf. R.A.E.*, A **25** 194], having not yet reached certain natural boundaries formed by either dry thorn scrub savannah country or by high mountains. It seriously damages cotton, a new crop in this area, and yams and also attacks pigeon peas [*Cajanus cajan*], sweet potatoes and beans. Morphological characters distinguishing living examples of *P. kenyae* and *P. citri*, Risso (*lilacinus*, Ckll.) obtained from South India are described [*cf.* **23** 607] and it is stated that imported endoparasites of the latter will not attack the former. An account is given of the spread of *P. kenyae* subsequent to the original outbreak in 1923, and the formation of its association with *Pheidole punctulata*, Mayr [**15** 566], which was already present in this area. From this it is concluded that the mealybug is an introduced species in Kenya, a view supported by its lack of predators and specific primary parasites and its absence in two areas in the Northern Province of Tanganyika Territory, closely resembling the Central Province of Kenya in flora, fauna and climate.

Banding against *Pheidole* [**20** 670, etc.] is a fairly effective, though expensive, means of control. The effects of sprays on the mealybug and sprays, poison baits and soil fumigation on the ant have not appeared promising. Recent observations indicate that it is impossible to correlate outbreaks of the mealybug in this locality with any known local factors, but that the presence of *Pheidole* is critical.

Jannone (G.). **Aspetti bio-morfologici e somatometrici del problema delle fasi nel *Dociostaurus maroccanus* Thunb. in Italia e fuori, con particolare riguardo alla provincia di Napoli. Secondo contributo.** [Bio-morphological and somatometric Aspects of the Problem of Phases in *D. maroccanus* in Italy and elsewhere, with particular Reference to the Province of Naples. Second Contribution.]—*Boll. Lab. Ent. agrar.* **1** pp. 261–328, 15 figs., 24 refs. Portici, 4th June 1938.

This is a report of further investigations [*cf. R.A.E.*, A **22** 605] on *Dociostaurus maroccanus*, Thnb., in its reservations in the Province of Naples. The existence of phases in this locust is confirmed, and biometrical and colour characters differentiating them are dealt with ;

the best biometric characters are the length of the body and the relative length of the elytron. In cage experiments, the average number of eggs per pod was 25–33 per cent. smaller in phase *solitaria* than in phases *congregans* or *gregaria*. This is not due to any anatomical differences, but to the smaller size of *solitaria* females. Of numerous adults of the egg-parasite, *Mylabris variabilis*, Pall., collected in 1932–37, those from the zones of phase *solitaria* were slightly smaller than those from the zones of phase *congregans* [*cf.* **21** 218]. The absence of extreme phase *gregaria* in the Province during the six years 1932–37 is thought to have been due to the successful annual anti-locust campaigns.

Bellio (G.). **La fumigazione di piante da vivaio ed ornamentali, di casse di frutta, e i diversi usi di una nuova tenda di fumigazione.** [The fumigation of Nursery and ornamental Plants, of Cases of Fruit, and the various Uses of a new Fumigation Tent.]—*Ann. Fac. Agrar. Univ. Napoli* (3) **9** pp. 83–120, 8 figs., 37 refs. Portici, 23rd April 1938.

Fumigation in air-tight chambers with hydrocyanic acid gas and in a vacuum with this or other fumigants is discussed, some published work on these subjects being noticed. For use by nurserymen in the province of Pistoia, the author has designed three types of fumigation chambers, namely a main permanent chamber to be built in a suitable place, several portable chambers constructed in sections for assembly where required, and a new form of fumigation tent, which has given satisfactory results in practice. The tent consists of a large square of closely woven cotton fabric supported on a frame. The uprights of the frame fit into sockets driven into the ground, and both they and the cross-pieces are formed of joined sections, so that the size of the tent can be varied as required. A tape marked off with a scale permits the capacity to be quickly determined, and tables show the correct dosages of sodium cyanide. Long bags filled with sand or earth serve to hold down the edges of the tent. It can be used in the field or in greenhouses, and, without the frame, for fumigating stacked boxes of packed fruit.

Dotti (F.) & Rossi (L.). **Osservazioni sullo sfarfallamento primaverile della *Cydia pomonella* L.** [Observations on the Spring Emergence of *C. pomonella*.]—*Note Fruttic.* **16** no. 6 pp. 94–96. Pistoia, June 1938.

Observations carried out from 1934 to 1937, inclusive, in the Massalombarda district, west of Ravenna, confirmed others made in the region of Verona on the interval between the fall of apple petals and the emergence of adults of *Cydia pomonella*, L. [*R.A.E.*, A **21** 372], which in the 4 years under review was 10 days. First-generation larvae, therefore, begin to enter the fruitlets about 20–25 days after petal fall. Emergence is slow at first, and generally extends from 10th May to mid-June, although in 1936 it lasted until July. To obtain a reliable indication of the date and character of emergence, and consequently of spray requirements, it is necessary to keep from 1,000 to 2,000 cocoons under observation in cages sufficiently large to avoid excessive humidity and cold [*cf.* **24** 758].

Candioli (P.). **Risultati ottenuti in tre anni di lotta contro la** *Cydia molesta*, **Busck nel Veronese.** [Results obtained in three years of Control against *C. molesta* Busck in the Region of Verona.]—*Note tec. Ist. Ent. Bologna* no. 4, 22 pp., 17 refs. Bologna, 1938.

Istruzioni e norme per la lotta artificiale contro la *Cydia molesta* **Busck.** [Instructions and Rules for the artificial Control of *C. molesta*.]—*Circ. Ist. Ent. Bologna* no. 2, 4 pp. Bologna, 25th April 1938.

In the first paper, the results are given of work in 1935–37 on the control of *Cydia molesta*, Busck, in orchards of peach and other fruits in the region of Verona. *C. molesta* was first observed in the region in 1933 and had spread, at the rate of 12–18 miles per year, throughout it by the end of 1935.

The following are the author's conclusions: In orchards that are 2–2½ miles from others, and contain only early-maturing varieties of peach and no other food-plants of *C. molesta*, infestation is slight and control measures are not required [*cf. R.A.E.*, A **25** 485]. The larvae are found, particularly in the early stages of development, in shoots in the upper part of the tree. They often hibernate in cracks in the bark, sometimes reaching the inner bark and even hollowing out a refuge in it. Hibernation occurs mainly on or near trees of late maturing varieties or in fruit storerooms, and the moths first appear in orchards nearby. The only really effective measures are the removal and immediate destruction of infested shoots, prunings and fallen fruits, banding and the destruction of hibernating larvae, and of the resultant adults on the trees and in the stores [*cf.* **24** 125]. Success depends on the frequency, regularity and care with which the work is done. The use of insecticides is uneconomic on peach, but pears, which are first attacked severely about mid-August, can be protected by lead arsenate sprays applied to keep the fruits covered from then onwards. In experiments, two applications, at the middle and end of August, of a spray containing 0·4 per cent. lead arsenate and 0·5–0·6 per cent. soap gave over 80 per cent. control.

In the second paper, the measures recommended in the first are summarised for the benefit of fruit-growers.

Feytaud (J.). **Recherches sur le Doryphore. 4. L'acclimatation d'insectes entomophages américains ennemis du** *Leptinotarsa decemlineata* **Say.**—*Ann. Épiphyt. Phytogén.* (N.S.) **4** fasc. 1 pp. 27–93, 25 figs., 6 refs. Paris, 1938.

This paper is the fourth of a series [*cf. R.A.E.*, A **25** 649, etc.] and is a review of work carried out in France from 1928 to 1937 on the introduction from the United States and Canada of parasites and predators for the control of *Leptinotarsa decemlineata*, Say, on potato [**22** 434; **25** 365, etc.]. The history of each consignment is given, with a detailed account of the laboratory technique used in breeding each species. Although adults of both sexes of *Doryphorophaga aberrans*, Tns., emerged from imported puparia, all attempts to breed this Tachinid failed. One generation of *D. doryphorae*, Riley, was successfully reared in the autumn of 1935, the larval and pupal stages both lasting about twelve days, but it did not survive the winter. It is suggested that attempts to acclimatise this species might be more successful if breeding were undertaken in the autumn in America and

the resulting puparia sent to France towards the end of the winter, so that adult flies could be obtained in the spring.

From 1933 to July 1937, six generations (rather more than one annually) of the predatory Carabid, *Lebia grandis*, Hentz, were reared under laboratory conditions [*cf.* **25** 648]. Either mature larvae or pupae of *Leptinotarsa* were suitable as food.

The breeding of *Perilloides* (*Perillus*) *bioculatus*, F., was satisfactorily carried out when the bugs were kept in cages with a humidity of 65–75 per cent., and a temperature of about 28°C. [82·4°F.]. In addition to larvae of *Leptinotarsa* on potato leaves or slices of green tubers, pots of *Sedum* were kept in the cages and were sprayed with water every day. The cages were well lit and partly warmed by electric lamps placed outside. When pairs of adults were placed in each cage and the temperature averaged 28°C. during the day, with a minimum of 22°C. [71·6°F.] at night, pairing generally began in 8 days or sometimes less. Eggs were deposited mainly on the leaves of the *Sedum*. When they begin to hatch, it is advisable to remove the adults to another cage. Nymphs in the first instar imbibe plant juices, but after the first moult they attack the *Leptinotarsa* larvae. When they reach the fifth instar they should be placed in another cage, as they become very sluggish on approaching the last moult and are then liable to be attacked by the younger nymphs. The young adults were provided with plenty of food and kept at 25°C. [77°F.] for 8 days before being placed in the breeding cages. Before hibernation, they were kept at 20°C. [68°F.] for a month and then placed in cages with special shelters consisting of strips of wood fixed together so that they are separated by rather less than a quarter of an inch.

The breeding of *Podisus maculiventris*, Say, which is discussed more fully in the following paper, gave excellent results and liberations have been made in many departments [**25** 648].

Observation cages containing *Lebia*, *Perilloides* or *Podisus* have been widely distributed in France so that the effect of different environmental conditions can be estimated. The authors suggest that *P. podisus* will probably be easily acclimatised throughout France, except perhaps in the south-east, and that *Perilloides* will establish itself in all the southern districts. The best centres for the distribution of both Pentatomids are those where plenty of natural shelter with a certain degree of humidity is available, even in the hottest weather.

COUTURIER (A.). **Contribution à l'étude biologique de** *Podisus maculiventris* **Say prédateur américain du doryphore.**—*Ann. Épiphyt. Phytogén.* (N.S.) **4** fasc. 1 pp. 95–165, 25 figs., 11 refs. Paris, 1938.

This study on the bionomics of *Podisus maculiventris*, Say, which was introduced from the United States into France for the control of *Leptinotarsa decemlineata*, Say, on potato [*cf.* preceding abstract], is based on laboratory observations in the latter country and deals particularly with the effect of temperature on development and behaviour.

The rearing technique is described in detail. Eggs deposited on muslin or leaves were placed on a double layer of muslin in Petri dishes and incubated at 25–27°C. [77–80·6°F.], with pieces of potato stem to provide humidity. The nymphs were removed daily and placed in

other Petri dishes under the same conditions until the first moult, when they were kept in lamp globes covered with muslin and containing a small branch of *Ruscus aculeatus*, and a piece of potato stem. Fifth-instar nymphs were removed to larger cages. Last-instar larvae of *Ephestia kuehniella*, Zell., were used as food so far as possible, the supply being renewed daily after the cages had been sprayed with water. Development was satisfactorily accelerated by keeping the nymphs at 29–30°C. [84·2–86°F.].

In the field, eggs are usually deposited on the upper surface of the leaves in an exposed position ; in the breeding cages they were deposited anywhere, but chiefly on strips of muslin, which were replaced at regular intervals. The maximum number of eggs produced by a single female was 1,097 ; the average output was 15 daily and 500–600 altogether. The threshold of development is 11–12°C. [51·8–53·6°F.], but at least 15–16°C. [59–60·8°F.] is necessary for satisfactory hatching. The incubation period at 16, 21 and 28°C. [60·8, 69·8 and 82·4°F.] lasted 16–17, 8–9 and 4 days, respectively. The eggs did not develop after prolonged exposures to 10 or 35°C. [50 or 95°F.]. The 5 nymphal instars together lasted 4–5 months at 15°C., 27–30 days at 23°C. [73·4°F.] and 20–24 days at 27·5°C. [81·5°F.]. There was a high mortality in first-instar nymphs at 15°C., and at 35°C. they were unable to moult. Only fifth-instar nymphs survived exposure to temperatures that in three weeks were reduced from 8 to 0°C. [46·4 to 32°F.], and for the following five weeks oscillated between 0 and 3·5°C. [38·3°F.]. This suggests that only adults and fifth-instar nymphs could survive the winter in France. The males develop slightly more rapidly than the females. At 23–24°C. [73·4–75·2°F.], nymphs fed on *Ephestia* completed their development 2–3 days sooner than those fed on *Leptinotarsa*.

Pairing takes place a few hours after the final moult and, at 25°C., oviposition begins about a week later. Eggs are not deposited below 15°C. The daily output increases with the temperature up to 22°C. [71·6°F.], is fairly stable from 22 to 27°C. [80·6°F.], reaches its maximum at 29–30°C. and then falls off. Parthenogenesis has not been observed, but females paired before October and then separated from the males deposited fertile eggs 10 months later.

There was a high mortality rate among adults kept without water in hibernation cages, suggesting that frequent spraying with water throughout the winter is necessary. There is no winter diapause, as though the adults become completely torpid at 3°C. [37·4°F.], they quickly regain their activity when the temperature is raised.

In the winter of 1934–35 there was a high rate of survival in the insectary, although the temperature from November to January, inclusive, averaged only 6·5°C. [43·7°F.], and there were three periods with minima below —5°C. [23°F.]. It is probable that acclimatisation will be successful only in regions where the average temperature of the warmest month is above 15°C. and that the optimum conditions in Europe will be found in countries with a July isotherm of 20°C. In France the relative dryness of the summer months is the chief obstacle to the establishment of the bug.

P. maculiventris has been found to attack a great variety of insects, a list of which is given. It sometimes sucks plant juices but causes no serious damage. First-instar nymphs feed on plants, although in the absence of fresh foliage they may suck insect eggs, including those of their own species.

FEYTAUD (J.). **Destruction du doryphore par l'oxyde d'éthylène sous vide partiel.**—*Ann. Épiphyt. Phytogén.* (N.S.) **4** fasc. 1 pp. 167–198, 9 refs. Paris, 1938.

This account of vacuum fumigation of potatoes with ethylene oxide, alone or with carbon dioxide, for the control of *Leptinotarsa decemlineata*, Say, is based on experiments, described in detail, that were carried out in France from 1935 to 1937, inclusive. The partial vacuum was obtained by reducing the pressure of the fumigation tank to about 50 mm. [about 2 ins.]. The gas and then air were introduced until the absolute pressure was about 50 mm. below atmospheric pressure; and the equilibrium was maintained at this level for 1 or 1½ hours. Air was then admitted until atmospheric pressure was reached, but pressure was reduced twice, to 150 and 250 mm., respectively, before the tank was opened. The test insects were generally placed in small cages in the middle of the sacks of potatoes. They were considered to be dead when no movement of the tarsi or palps was observed or could be provoked by warmth.

In all cases, the rate of fumigation is calculated for the capacity of the tank after deduction of the volume occupied by the sacks of potatoes and the amount of the fumigant is expressed as gm. per cu. metre, equivalent to oz. per 1,000 cu. ft. In preliminary investigations, the adults were unaffected by an exposure of 1½ hours to a partial vacuum, or to carbon dioxide at the rate of 530 gm. at 18·9°C. [66·02°F.]. In a series of experiments in June 1935 at varying temperatures and pressures, an exposure of 1½ hours to 16 gm. or a higher dose of ethylene oxide was lethal to all the adults within 5 days. When parallel tests were carried out in July in 2 tanks with capacities, respectively, of 1·28 and 29 cu. m. [about 45 and 1,024 cu. ft.], exposures of 1 and 1½ hours to ethylene oxide at the rate of 24–25 gm., alone, or mixed with about 50 gm. carbon dioxide, killed all adults (and incidentally larvae and eggs) in sacks of potatoes within about 3 days and 24 hours, respectively. When the amount of carbon dioxide was increased to 200 gm., an exposure of 1 hour killed all the adults within 24 hours, but when the amount of ethylene oxide was reduced to 20 gm. some survived for nearly 5 days.

When eggs of *Leptinotarsa* were placed in containers inside sacks of potatoes, all were killed by an exposure of 1 hour at 20°C. [68°F.], or higher temperatures, to a mixture of 15 gm. ethylene oxide and 200 gm. carbon dioxide, but below 68°F. dosages of 20 and 40 gm. ethylene oxide did not give complete mortality. In an empty tank maintained at 18°C. [64·4°F.] or above, all larvae at any stage of growth were killed within 48 hours by an exposure of 1 hour to 15 gm. or more of ethylene oxide; but at 7–14°C. [44·6–57·2°F.] when the larvae were placed in containers inside the sacks of potatoes and 200 gm. carbon dioxide was mixed with the ethylene oxide, 60 gm. of the latter was required for a satisfactory mortality [*cf. R.A.E.*, A **20** 696]. At temperatures below 12°C. [53·6°F.], ethylene oxide becomes liquid, so that the gas-generating containers must be warmed, and care must be taken to eliminate the possibility of condensation in the connecting pipes. Pupae were very susceptible to fumigation, both when they were placed in the middle of the sacks and in an empty tank. At 8·8–11·8°C. [47·8–53·24°F.], complete mortality resulted from fumigation with a mixture of 200 gm. carbon dioxide and 20 gm. or a higher dose of ethylene oxide.

Exhaustive tests showed that neither the power of germination nor the market value of well-dried potatoes was adversely affected by exposures of 1 and 1½ hours to 40 and 30 gm. ethylene oxide, respectively, and that usually even 120 gm. produced no ill effect. Freshly dug potatoes that are still damp do not withstand fumigation so well.

Bozzini (G.). **Un nuovo insetto dannoso al giaggiolo in Italia.** [A new Insect Pest of Iris in Italy.]—*Giard. fiorito* 27th April 1938 repr. 7 pp., 5 figs. Florence, 1938.

The sawfly, *Rhadinoceraea reitteri*, Konow, not previously recorded in Italy, was found in 1929 attacking *Iris* in Verona. Observations during the next 8 years showed that the adults appear in mid-April and pair, and the females deposit about 20 eggs each, in batches of 3–12 in the leaves, preferably of *Iris germanica*. The larvae, which hatch in about 10 days, feed on the leaves and sometimes on the flower-buds. From 40 to 70 per cent. of the leaves have been found injured. After about a month, the larvae enter the ground, where they pass summer, autumn and winter in the prepupal stage in cocoons, and pupate in the spring. Birds feed on the larvae, which can be controlled if necessary by a 0·5 per cent. spray of lead arsenate.

James (H. C.). **The Effect of the Humidity of the Environment on Sex Ratios from over-aged Ova of** *Pseudococcus citri* **Risso (Hemipt. Coccidae).**—*Proc. R. ent. Soc. Lond.* **13** pt. 4–6 pp. 73–79, 2 figs., 2 refs. London, June 1938.

The following is taken from the author's summary of experiments on the effect of humidity on sex ratios in *Pseudococcus citri*, Risso, on *Coleus* [*cf. R.A.E.*, A **26** 105] : The mean of the family sex ratios of females kept in dry air during the maturation of their ova and a subsequent period of over-ageing gave a statistically significant larger proportion of females when compared with the mean ratio from females kept in saturated air during a corresponding period at the same temperature. While the differences are sufficiently large to show that drier environments favour the production of females in *Pseudococcus*, they are not large enough to suggest that the humidity of the environment is the principal factor producing alterations in sex ratios by over-ageing the ova.

Musgrave (A. J.) & Mackinnon (D. L.). **Infection of** *Plodia interpunctella* **(Hb.) (Lepidoptera, Phycitidae) with a Schizogregarine,** *Mattesia dispora* **Naville.**—*Proc. R. ent. Soc. Lond.* **13** pt. 4–6 pp. 89–90, 1 fig., 4 refs. London, June 1938.

Larvae from an unhealthy culture of *Plodia interpunctella*, Hb., were heavily infested with a schizogregarine thought to be *Mattesia dispora*. There were no external symptoms by which the presence of the parasite could be detected. Observations suggested that this protozoon is highly pathogenic, and that it also occurs in pupae and adults of the *Plodia* ; eggs were not examined. The infected cultures had been kept for some time at laboratory temperatures in a rather dry atmosphere that may possibly have increased the susceptibility of the

host to attack. The larvae probably ingest spores in contaminated food. Sterilisation at high temperatures might kill the spores in the food, but would probably upset its vitamin content.

Diakonoff (A.) & de Boer (S.). **Bestrijding van schadelijke voorraadinsecten door middel van koelen.** [The Control of Pests of stored Products by Means of Cold Storage.]—*Ber. HandMus. kolon. Inst. Amst.* no. 120, 20 pp., 52 refs. Amsterdam, 1938. (Repr. from *De Indische Mercuur* no. 8 p. 97, 23rd February 1938.) (With a Summary in English.)

Investigations were made in Amsterdam in 1937 on the effect of low temperatures on insect pests of stored products. The exposures necessary for control were calculated after the temperature of the products had fallen to the required level, which in the case of bales took several days, and care was taken to prevent moisture condensing on them after transfer to atmospheric conditions. The results are tabulated. Unless otherwise stated the low temperature used was −11 to −13°C. [12·2–8·6°F.]. Larvae of *Ephestia elutella*, Hb., in small samples and in bales of about 130 lb. cacao beans were all killed by exposure for 1 and 5 days, respectively. Eggs in bales were killed in 1 day, but warm weather, with a temperature of 21–22°C. [69·8–71·6°F.] may have reduced their resistance. Mature larvae of *Aphomia* (*Paralipsa*) *gularis*, Zell., in bales of about 210 lb. apricot kernels and boxes of about 88 lb. currants, were all killed by exposure for 3 days, but the percentage mortality of mature larvae of *Plodia interpunctella*, Hb., in the same materials was only 94–96 after 5 days. Interrupted exposure increased the susceptibility of resistant insects; the periods required to kill all adults, pupae and larvae of *Dermestes* in bags of infested cow hair were 9 days for continuous exposure and 6 for exposure interrupted by 2 days at 15°C. [59°F.]. The percentage mortality of larvae of *E. elutella* in samples exposed to −4°C. [24·8°F.] was 38·9 after 14 days, and of larvae of *A. gularis* after 2 days only 16·7, but the latter figure was raised to 50 when the larvae were kept for a further 3 days at 20°C. [68°F.] and then exposed to −4°C. for 3 days.

Eckstein (F.). **Betrachtungen zur Maikäferbekämpfung.** [Reflections on Cockchafer Control.]—*Anz. Schädlingsk.* **14** pt. 5 pp. 49–51. Berlin, 15th May 1938.

The author discusses from two actual cases in Germany the practical difficulties and the cost of organised collections of adults of *Melolontha* and stresses the necessity of further investigations on the habits of the larvae.

Bekämpfung eines Holzschädlings, der Hausbocklarve. [The Control of a Timber Pest, the Larva of *Hylotrupes bajulus*.]—*Anz. Schädlingsk.* **14** pt. 5 pp. 57–58. Berlin, 15th May 1938.

From an official survey of about 140 thousand buildings in Germany, it appears that the larvae of *Hylotrupes bajulus*, L., occur in the attics of about 40 per cent. of all German houses, though the timber is structurally weakened in only a few cases. It has been calculated that

a house would collapse in 25–30 years if the beetle could spread in it undisturbed. Control is a problem of great importance and is at present the subject of intensive study by various organisations.

FISCHER (W.). **Analyse von Pflanzenschutzmitteln. I. Dinitrokresol.** [The Analysis of Insecticides and Fungicides. I. Dinitrocresol.] —*Z. anal. Chem.* **112** pt. 3–4 pp. 91–96. Munich, 1938. **II. Pyrethrum.**—*Op. cit.* **113** pt. 1–2 pp. 1–8, 7 refs.

In the first paper, the author describes a colorimetric method for determining minute amounts of dinitrocresol in insecticides or on plants, and in the second, a colorimetric method for determining amounts of pyrethrin I down to 0·1 mg.

DAXER (H.). **Die Einwirkung von Giftstoffen auf die Pflanze. I. Grundlegende physiologische Fragen und Versuche zur Klärung der Arsenwirkung.** [The Action of poisonous Substances on Plants. I. Basic physiological Questions and Experiments to elucidate the Action of Arsenic.]—*Z. PflKrankh.* **48** pt. 6 pp. 273–295, 37 refs. Stuttgart, 1938.

The author considers that the discovery of fully effective substitutes for dangerous arsenical insecticides is likely to be difficult, as all the better-known poisons have been examined and found inadequate, but that it might prove possible to reduce the amount of arsenic in an insecticide to a point harmless to health by the admixture of substances that would increase the toxicity of arsenic to insects without increasing its harmful action on plant tissues. The usefulness of a new substance would depend largely on its effect on plants, and as little is known of the development of the toxic effect of arsenicals on plant tissue (of which scorching is the outward manifestation), the author carried out investigations in order to provide a basis and method for testing such substances. The various possible ways in which insecticides may be absorbed by the leaf epidermis are discussed. Poisons penetrate the uninjured epidermis only when in solution, normally through the cuticle and occasionally through the stomata. Scorching depends mainly on the solubility of the poisonous coating and on the wetting period (the period during which the insecticide on the leaf remains in solution). To determine the effect of varying the wetting period, leaves on the plant were immersed in small pots containing a solution or suspension of the substance to be tested. The pots, which were made of waxed paper, could be tied in any suitable position on the plant. After the pot was removed, any droplets left on the leaf quickly evaporated, so that the period of immersion could be considered as that of wetting. The results with various calcium arsenates are tabulated and show that scorching increases directly with the wetting period. Owing to the different activity of the calcium arsenates commercially manufactured by dissimilar methods, these compounds are unsuitable for a closer investigation of the effect of wetting time. It was found that the amount of scorching caused by a sample was correlated with the amount of water-soluble arsenic in it, and that, in the case of samples of the same composition, particularly as regards the amount of calcium, those suspensions that had an alkaline reaction appeared to produce scorching more readily.

Börner (C.) & Schilder (F. A.). **Die Verbreitung der Reblaus in Deutschland nach dem Stande des Jahres 1937.** [The Distribution of *Phylloxera* in Germany in 1937.]—*Beil. NachrBl. dtsch. PflSchDienst* **18** no. 6, 14 pp. Berlin, June 1938.

Phylloxera was found on vines in 65 new localities in Germany in 1937 [*cf. R.A.E.*, A **25** 485]. In 60 localities the form with a short proboscis was recorded, either alone or with the form with a long proboscis. The latter occurred in 186 localities, but again was not observed infesting the leaves.

[Semenov (A. E.) & Pankova (I. A.).] **Семенов (А. Е.) и Панкова (И. А.). The Effect of the Larvae of the Flax Weevil on the Structure of the Flax Fibre.** [*In Russian.*]—*Len i Konoplya* **15** no. 5 pp. 45–48, 3 figs. Moscow, 1938.

This paper contains a brief account of the bionomics of the flax weevil [*Ceuthorrhynchus sareptanus*, Schultze] in Siberia [*cf. R.A.E.*, A **26** 6, 351]. Considerable damage to cultivated flax [*Linum usitatissimum*] is caused by the larvae, which mine in the centre of the stem, forming tunnels 1–2 ins. long, but adult feeding on leaves and stems is of no economic importance. Since the oviposition period lasts about 2 months and females prefer the upper part of the stalks, the plants become infested in different phases of development, and larvae of succeeding instars often occur in layers in a stem, a maximum of 7 individuals having been observed in one instance. The larval stage lasts 20–24 days, but larvae are present in a plant for about two months. Infested plants are checked in growth and may reach only 4–6 ins. in height, instead of the normal 3 ft.; the infested parts of the stems become thick, and intense ramification and foliation take place. The changes caused by infestation to the structure of the stems of cultivated and wild perennial flax [*Linum perenne*] are discussed in detail. The quality of the fibre from infested plants is considerably lowered, as it is short and its strength is only one-third of the normal.

The Occurrence and Treatment of bark-eating Caterpillars and Borers.—*Memor. Tocklai exp. Sta. Indian Tea Ass.* no. 1, 4 pp. Calcutta, May 1938.

Injury by caterpillars that attack the bark of tea has increased in Assam of recent years. The commonest are *Indarbela* (*Arbela*) *dea*, Swinh., which also attacks mango and wild figs, *I.* (*A.*) *quadrinotata*, Wlk., which is more numerous on mango, figs, *Albizzia stipulata*, and other trees, and the Tineids, *Ptochoryctis simbleuta*, Meyr., and *Comocritis pieria*, Meyr., both found only on tea. Various stages of these four species are briefly described. Their life-histories are similar. The adults are active from April to June, and the females deposit up to 300–400 eggs each, usually in forks in the older wood, or where twigs have broken off or been badly pruned. The egg and larval stages last 2–3 weeks and about 9 months, respectively, pupation occurring early in March. The Tineid larvae feed under shelters of web, which may cover a considerable part of the stem. They eat through the bark into the wood, and, if attack is severe, the movement of sap is stopped and the plant ceases to flush. A larva of the species of *Indarbela* bores a hole into the wood in which it retreats during the heat of the day and eventually pupates. It emerges to feed on the

bark and, while doing so, constructs round the stem a spiral shelter of pieces of bark and excreta spun together with silk.

The preference of these pests for badly pruned tea makes careful pruning with avoidance of snags the best preventive measure. The larvae may normally be destroyed by burying the prunings, supplemented by removal of the webs of the Tineids and by applying tar or oil to the entrances of the holes of the species of *Indarbela*. Abandoned tea should be burnt. Bushes may be protected from attack by applying strong lime-sulphur (8°Bé.) or 1 per cent. sodium hydroxide to them after pruning, as the larvae will not feed on the softened bark.

Munro (H. K.). **Studies on Indian Trypetidae (Diptera).**—*Rec. Indian Mus.* **40** pt. 1 pp. 21–37, 7 figs. Calcutta, April 1938.

Systematic notes are given on a number of Trypetids collected in India, and four new species are described. The material examined included five specimens of *Ceratitis capitata*, Wied., which had been obtained at Pusa, three of them having been reared from peach. This apparently constitutes the first record of *C. capitata* from the oriental region.

Cherian (M. C.) & Israel (P.). **Studies on *Elasmus zehntneri*, Ferr., a Parasite of the Sugarcane White Moth Borer (*Scirpophaga*).**—*Madras agric. J.* **25** no. 9 pp. 273–279. Madras, September 1937. ***Rhaconotus scirpophagae*, Wlk., a Parasite of the Sugarcane White Moth Borer (*Scirpophaga*).**—*Op. cit.* **26** no. 4 pp. 127–134, 1 pl. April 1938.

These two papers comprise accounts of studies on *Elasmus zehntneri*, Ferrière, and *Rhaconotus scirpophagae*, Wlkn., respectively, both external parasites of the larvae of *Scirpophaga* infesting sugar-cane in Madras. In each paper the habits of the host larvae [*R.A.E.*, A **26** 408] and the immature stages of the parasite are briefly described, and the original description of the adult [**18** 198; **16** 47] is quoted. Each parasite oviposits in the same way. The female paralyses the host larva in a sugar-cane stem by thrusting its ovipositor through the thin cover of the exit hole, a process only possible when the larva is in the end of its tunnel [**26** 408], and then deposits a cluster of eggs on the wall of the tunnel or on the head of the larva.

Females of *E. zehntneri* oviposited 2–4 days after emergence, and laid an average total of 53 eggs, the number varying from 30 to 97. The average number of eggs in a cluster was 36. More than one female sometimes oviposited on a host; the number of adults obtained from individual host larvae taken in the field varied from 30 to 170, with an average of 75, females being twice as numerous as males. The egg, larval and pupal stages lasted 19–21 hours and 2–4 and 7–10 days, respectively. The larvae pupate without spinning cocoons. When fed on honey solution, males and females lived for up to 7 and 26 days, respectively, but neither survived for more than 3 days without food. The parasites were most abundant from August to January.

Of adults of *Rhaconotus scirpophagae* reared from cocoons collected in the field, 84 per cent. were females. On an average, 12 adults were obtained from each host larva, with a maximum of 21 and a minimum of 5. In the laboratory, adults survived for only a few days if given no

food. When fed on honey solution, females lived for up to 107 days, with an average of 38, or 27 if allowed to lay eggs ; males lived for an average of 30 days. Most females oviposited twice, with an interval of 2–10 days, and there were usually 10–15 eggs in a cluster, or occasionally 20–25. A female did not attack a host that had already been parasitised, oviposited on only one of a number of available host larvae, and did not accept exposed larvae. If only one host is available for a number of parasites, however, some may oviposit on it simultaneously. Parthenogenesis occurred, giving rise to males.

The egg, larval and pupal stages lasted 1–3, 6–10 and 11–16 days, respectively. The larvae feed externally on the host, which they suck empty in about 4 days, and then spin cocoons on it, in which they pupate 1–5 days later. The percentage of parasitism was highest in January–April, and slight in October–December and May.

CHERIAN (M. C.) & BASHEER (M.). **A new Cecidomyiad Pest of Moringa.**—*Madras agric. J.* **26** no. 3 pp. 92–95, 1 pl. Madras, March 1938.

This is an account of investigations on the bionomics of *Stictodiplosis moringae*, Mani, infesting *Moringa pterygosperma* in Madras [*cf. R.A.E.*, A **26** 55]. The immature stages of this Cecidomyiid are briefly described, and the original description of the adult is quoted.

The female deposited its eggs mostly on the anthers of medium-sized buds in clusters of 5–80. The newly-hatched larvae fed on the internal tissues of the bud, which turned yellow, withered, and sometimes dropped. When the buds dropped or the flowers opened, the larvae emerged and pupated in cocoons in the soil beneath the tree. The egg, larval and pupal stages lasted 1, 6–9 and 5–9 days, respectively. Adults lived for about 2 days, and feeding did not increase their longevity. The larvae, which occurred throughout the year, were parasitised by an undescribed species of *Microbracon* and a Chalcidoid. Bordeaux mixture did not repel females and the only method of control suggested is to destroy the pupae by cultivating the soil.

VAN DER LAAN (P. A.). **Plagen der tabak.** [Pests of Tobacco in Deli, Sumatra, in 1937.]—*Meded. Deli Proefst.* (2) no. 98 pp. 10–15. Medan, 1938.

Records are given of the incidence of a number of the common pests of tobacco in Deli, Sumatra, in 1937. The grasshopper, *Valanga nigricornis*, Burm., was abundant and caused much injury.

KATÔ (M.). **The Temperature Limit of Activity of the Strawberry Weevil,** *Anthonomus bisignifer* **Schenkling.**—*Sci. Rep. Tôhoku Univ.* (4) **12** no. 4 pp. 501–510, 2 figs., 18 refs. Sendai, April 1938. **The Diurnal Activity of the Strawberry Weevil,** *Anthonomus bisignifer* **Schenkling, with a Note of the ecological Meaning of the solar radiant Energy.**—*T.c.* pp. 511–530, 4 figs., 10 refs.

In the first paper, details are given of experiments on small numbers of adults of *Anthonomus bisignifer*, Schenk., in Japan, showing that they begin to crawl at about 49·5°F. and to fly at about 73°F. The second contains an account of observations on the weevils on strawberry showing that they are active during the day and, except at high

temperatures, inactive at night, and that solar radiation causes activity when the temperature of the air and soil is lower than that at which activity begins in the laboratory.

KONO (H.). **Relation of Wolf's relative Sun-spot Number to the periodical Outbreaks of *Porthetria dispar*, L., in Japan.** [*In Japanese.*]—*Bot. & Zool.* **6** no. 8 pp. 1361–1376, 2 figs. Tokyo, August 1938.

In Hokkaido and other cooler parts of Japan, *Lymantria* (*Porthetria*) *dispar*, L., has generally caused serious damage to apple and larch (*Larix*) in years in which Wolf's relative sun-spot numbers were over 50. In the south of Gifu Prefecture, it damaged persimmon seriously in years when the sun-spot numbers were less than 20. At present, the sun-spots are reaching their maximum, and outbreaks are expected in the areas where apple and larch are cultivated.

YAGO (M.). **Brief Observations on the Insect and Fungous Pests of Pear Trees in 1937.** [*In Japanese.*]—*Agric. & Hort.* **13** no. 1 pp. 142–148, 4 figs. Tokyo, 1938.

In Shizuoka Prefecture, *Cydia* (*Grapholitha*) *molesta*, Busck, and *Tortrix* (*Cacoecia*) *xylosteana*, L., were abundant on pears in 1937, but *Paratetranychus pilosus*, C. & F., and *Pseudococcus* spp. were less numerous than usual. Although the Cicadids, *Graptopsaltria nigrofuscata*, Motsch., *Platypleura kaempferi*, F., and *Cryptotympana japonensis*, Kato, were less abundant than in preceding years, the adults were collected in considerable numbers in August, and posts in the pear orchards were painted with creosote to kill the eggs. The Aphid, *Toxoptera piricola*, Mats. [*cf. R.A.E.*, A **25** 676], which causes deformation of the young leaves and shoots, was scarce. A spray of 1 lb. pyrethrum and ½ lb. soap in about 40 gals. water gave effective control.

SAKAI (K.). **On the Food-plants of the Red Scale** (*Chrysomphalus aurantii*, **Mask.**). [*In Japanese.*]—*Agric. & Hort.* **13** no. 5 pp. 1205–1212, 2 figs. Tokyo, 1938.

Aonidiella (*Chrysomphalus*) *aurantii*, Mask., which attacks plants of 12 genera in Kagoshima Prefecture and is an important pest of *Citrus*, is commoner in the coastal regions than in the mountains. Lists are given of its food-plants in Japan and other parts of the world.

When crawlers of a scale insect on *Podocarpus*, considered by the author to be *A. aurantii*, were transferred to *Citrus*, only a few settled and these failed to reach the adult stage.

NAKAMURA (S.). **Observations on a Geometrid, a new Pest of Mulberry.** [*In Japanese.*]—*Agric. & Hort.* **13** no. 7 pp. 1628–1630, 3 figs. Tokyo, 1938.

An unidentified Geometrid caused serious damage to mulberry in Saitama Prefecture, north of Tokyo, in 1933. It has one generation a year, and overwinters in the pupal stage, the adults emerging in late March and early April. The female lays about 150 eggs, usually singly, in sheltered places on the food-plant. The larvae hatch in 15–20 days, moult 4 times and enter the soil for pupation in May.

Tamura (I.). **On *Autoserica japonica* Motsch., a noteworthy Pest of garden Crops and its Control.** [*In Japanese.*]—*Agric. & Hort.* **13** no. 7 pp. 1705–1708, 2 figs. Tokyo, 1938.

The adults of *Aserica* (*Autoserica*) *japonica*, Motsch., which is widely distributed in Japan, are injurious to soy bean, *Sesamum* and sweet potato in Ibaragi Prefecture and particularly to *Phaseolus radiatus*. The larvae pupate in June, and the adults occur from late June until September.

Ishii (T.). **Important Insect Pests of Vegetables, 1–3.** [*In Japanese.*] —*Agric. & Hort.* **13** pp. 1237–1244, 1449–1454, 1655–1658, 16 figs. Tokyo, 1938.

A popular account is given of the morphology, bionomics and control of the more important pests of vegetables near Tokyo. Those injurious to various crucifers are : *Pieris rapae*, L., of which the larvae are parasitised by *Apanteles glomeratus*, L., and the pupae by *Pteromalus puparum*, L., and *Brachymeria obscurata*, Wlk. ; *Barathra brassicae*, L., which usually has only two generations a year and of which a small percentage of the eggs are parasitised by *Trichogramma evanescens*, Westw. ; *Hellula* (*Oebia*) *undalis*, F., which is a serious pest of radish from late August to November and has three or four generations a year, hibernating in the larval stage ; *Phyllotreta vittata*, F. ; and the sawfly, *Athalia japonica*, Klug, which has three generations a year. *Phytomyza nigricornis*, Macq., which apparently has three or four generations a year, attacks both crucifers and pea ; adults, larvae and pupae occur together in May. *Rhaphidopalpa femoralis*, Motsch., feeds on cucurbits.

Yashiro (H.). **On the Food of *Bufo bufo miyakoensis* Okada and its Introduction into the Island of Okinawa.** [*In Japanese.*]—*Bot. & Zool.* **6** no. 6, pp. 1127–1130. Tokyo, June 1938.

During 1934–37, 142 adults of the toad, *Bufo bufo miyakoensis*, were introduced into Okinawa (Loochoo Islands) for the control of insect pests. Many tadpoles were recovered in the spring of 1938. An examination of the stomach contents of the toads showed that 95 per cent. was animal matter, and of this 59 per cent. was of insect origin.

Aoyama (T.). **A Pear Midge (Preliminary Report).** [*In Japanese.*]— *Rep. Jap. Ass. Adv. Sci.* **13** no. 3 pp. 473–476, 5 figs. Tokyo, June 1938.

Descriptions are given of all stages of an unidentified species of *Diplosis* that is very injurious to pear in Korea. It has two generations a year, the adults emerging in early May and in August, and overwinters in the larval or pupal stage. Females of the overwintered generation deposit 5–13 eggs each in the young pears in May, causing them to fall, and the larvae pupate in the soil in mid-July. First-generation females oviposit in the leaf stalks, and the larvae bore in the fruit buds near the stalks, 3–12 larvae occurring in a bud, and become full-fed in late September.

Okada (I.). **Relation of the Oviposition of** *Grapholitha glycinivorella* **Mats. to the Size of the Pods of Soy Bean in Manchuria. (Preliminary Report.)** [*In Japanese.*]—*Agric. & Hort.* **13** no. 4 pp. 973–978, 2 figs. Tokyo, 1938.

An account is given of observations and experiments in Manchuria showing that females of *Cydia* (*Grapholitha*) *glycinivorella*, Mats., prefer to oviposit in the larger pods of soy beans [*cf. R.A.E.*, A **26** 310].

Subramaniam (T. V.). **The Tobacco Stem Borer and its Control.**—*Mysore agric. Cal. 1938* pp. 13–14. Bangalore, 1938.

Brief notes are given on the bionomics and control of *Phthorimaea heliopa*, Lw. [*cf. R.A.E.*, A **22** 624], which is a serious pest of tobacco in Mysore. Seedlings may be protected to some extent by spraying with calcium arsenate at 5-day intervals. Tobacco plants should be uprooted and destroyed after harvest, as otherwise they act as foci of infestation.

Betrem (J. G.). **Gegevens omtrent de biologie van de dompolanluis** (*Pseudococcus citri*) **en de lamtoroluis** (*Ferrisiana virgata*). [Data on the Biology of *P. citri* and *F. virgata*.]—*Arch. Koffiecult. Ned.-Ind.* **10** pt. 2 pp. 43–84, 2 pp. refs. Surabaya, 1936. (With a Summary in English.) [Recd. May 1938.]

In view of the transfer of the investigation on white mealybugs attacking coffee in Java from the Malang to the Bezoeki experiment station, the data hitherto obtained on *Pseudococcus citri*, Risso, and *Ferrisiana virgata*, Ckll. [*cf. R.A.E.*, A **18** 362; **23** 12, etc.] are summarised here and compared with those from other countries [**16** 308; **17** 596].

The duration of the egg stage of *P. citri* varied considerably. In 1933 it averaged 2·9 days in August and 6·3 in November. In 1934, it was 3·6 in July and 5·6 in December. As all the eggs were kept at 27–28°C. [80·6–82·4°F.], the author considers that they were deposited in different stages of embryonal development. Variations in atmospheric humidity from 26 to 90 per cent. had no effect on the length of the stage. The length of the life-cycle from egg to egg varied in 1934 from 20·3 to 43·8 days, and was longer on cut branches than on coffee bushes, probably because of a difference in nutriment. The average number of eggs deposited per female was 300. Males were rare in nature and were not observed in the laboratory; there was some evidence that parthenogenesis occurs.

F. virgata was reared on lamtoro [*Leucaena glauca*]. The egg stage averaged 2·4 and 1·07 days in 1933 and 1934, respectively, but the author considers it to last less than 1 day in nature. In 1933, the interval between hatching and the first oviposition varied from 28 to 49 days and averaged 38·7. The average number of eggs deposited per female was over 300.

Mealybugs were spread by the wind, and also by rain, which washed them from their food-plants to a distance. The ant, *Anoplolepis* (*Plagiolepis*) *longipes*, Jerd., disseminated *P. citri* but did not visit *F. virgata*. Both mealybugs were positively geotactic.

BETREM (J. G.). **De oecologie en epidemiologie van de witte luizen.** [The Ecology and Epidemiology of White Mealybugs.]—*Arch. Koffiecult. Ned.-Ind.* **10** pt. 2 pp. 87–186, 13 figs., 5 pp. refs. Surabaya, 1936. (With a Summary in English.) [Recd. May 1938.]

This paper is primarily a compilation of available information on environmental factors influencing the abundance and spread of the white mealybugs [*Pseudococcus citri*, Risso, and *Ferrisiana virgata*, Ckll.] in Java and other regions [*cf.* preceding abstract]. Statistical methods of investigation are discussed, with examples from practical work, and numerous references are given to the literature.

The course of infestation of coffee by mealybugs is usually ascertained by counting the infested trees. The proportions of the various developmental stages are a further guide, for a preponderance of young individuals shows an increase to be of recent date. The size of the population present at the beginning of the dry season determines the rate of multiplication. The most important ecological factor is atmospheric humidity, which exercises an indirect effect through its influence on parasitic fungi. Windy areas are very susceptible to attack, hill tops being more infested than valleys. Infestation is greater in lightly shaded coffee [*cf. R.A.E.*, A **23** 12; **25** 196] and during the dry east monsoon. The influence of temperature on populations in Java is evident only in certain cases, but all plantations below an altitude of 300 ft. are probably too warm for infestation. Parasites and predators are of little importance as they are scarce at the beginning of an outbreak. A list of the genera of the known primary parasites of white mealybugs and records of fungi on them are given from the literature.

BETREM (J. G.). **De morphologie en systematiek van enkele van de voornaamste witte-luizensoorten van Java.** [The Morphology and Systematics of some of the principal White Mealybugs of Java.]—*Arch. Koffiecult. Ned.-Ind.* **11** pt. 1 pp. 1–118, 34 figs., 9 pp. refs. Surabaya, 1937. (With a Summary in English.) [Recd. May 1938.]

In the first chapter of this work the author deals with the morphology and anatomy of mealybugs (DACTYLOPIINAE), and in the second with their classification. Keys are given to the genera of DACTYLOPIINAE occurring in the Indo-Malayan region, together with some genera that are found on coffee elsewhere, and to the principal species of *Pseudococcus* found in south-eastern Asia, including also all the species attacking coffee in other parts of the world, excepting *P. cryptus*, Hemp., which is not known to the author and *P. coffeae*, Newst., which is considered unrecognizable. The species of *Pseudococcus* and 5 species of other genera are then discussed individually, with notes on their morphology, synonymy, food-plants and distribution.

The following new species are described from Java: *Pseudococcus pseudofilamentosus* on *Citrus*, *Erythrina* and coffee; *P. pseudocitriculus* on *Tephrosia vogelii*; *P. defluiteri* on coffee; *P. lepelleyi* on sour-sop (*Anona muricata*) and *Lansium domesticum*; and *P. deceptor* [*cf. R.A.E.*, A **21** 103] on roots of coffee, *Tephrosia vogelii*, kapok and *Sonchus arvensis*. *P. deceptor* may be identical with *P. cryptus*, which has the same habits and is found on roots of coffee and *Citrus* in Brazil [**16** 501; **24** 502].

The author considers that *P. crotonis*, Green, and *P. lilacinus*, Ckll., are synonyms of *P. tayabanus*, Ckll., and *P. citri*, Risso, respectively.

WILLIAMS (J. L.). *Phylloxera* **and the** *Phylloxera* **Board of South Australia.**—*J. Dep. Agric. S. Aust.* **41** no. 10 pp. 853–859, 18 figs., 1 pl., 8 refs. Adelaide, May 1938.

The biology of *Phylloxera vitifoliae*, Fitch (*vastatrix*, Planch.) and the history of its introduction from the United States into Europe are reviewed from the literature. It was first recorded from Australia in 1875 in Victoria, and now occurs also in New South Wales and in one locality in Queensland. Owing to the difficulty of eradication, and the necessity for grafting vines on American stock in areas in which it occurs, regulations prohibit the removal of vines from these states into South and Western Australia [*cf. R.A.E.*, A **24** 119], where it has not yet been found.

NEW SOUTH WALES. **Plant Diseases Act, 1924. Proclamation.**—*Govt. Gaz.* no. 16 repr. 1 p. Sydney, 4th February 1938. [Recd. July 1938.]

This proclamation requires that, in certain specified areas of New South Wales, all cases or boxes that have contained fruit shall be immersed in boiling water for 3 minutes or more not later than 15th August of each year for the control of *Cydia molesta*, Busck, and *C. pomonella*, L.

MOSSOP (M. C.). **Notes on Maize Weevil** (*Calandra oryzae*, **L.**).—*Rhod. agric. J.* **35** no. 6 pp. 415–416, 2 refs. Salisbury, S. Rhod., June 1938.

Although in 1937 maize fresh from the field in Southern Rhodesia was infested earlier than usual by *Calandra oryzae*, L., indicating a subsequent serious outbreak [*R.A.E.*, A **26** 203], the final infestation was comparatively light. The weevil was unable to breed intensively until rains, commencing in November, enabled the maize to absorb moisture. Infestation in the field was decidedly subnormal in May 1938, but the maize appeared to contain more moisture than usual for the time of year. The author therefore concluded that infestation would be light at the start of the ensuing storage season, but would then become normal, as the weevil would breed intensively early in the spring, unless the grain dried rapidly before the warm weather sets in. He suggests that the grain might with advantage be dried as much as practicable before storage.

ROBERTS (R.). **Ground Cornstalks and Cobs as Base Materials and Magnesium Sulphate and Sodium Fluosilicate as Poisons in Grasshopper Baits.**—*Bull. Neb. agric. Exp. Sta.* no. 312, 14 pp., 11 refs. Lincoln, Neb., December 1937. [Recd. July 1938.]

The following is largely taken from the author's summary: Scarcity and high cost of bran have made necessary the use of emergency substitute bases in grasshopper baits in Nebraska. The bait bases employed in the tests described in this paper were sawdust, maize stalks or maize cobs ground into small particles, and mixtures of

these three materials with a mill-run bran, using 7 parts by weight to 1 part bran. The mixture of maize stalks and bran was the most promising, baits made with it being about 65 per cent. as effective as those made with the coarse flaked wheat bran (without shorts) used as a standard. The mixture of maize, cobs and bran was next in effectiveness, but the maize stalks are more readily available, and their obviously better properties for making a bait (lighter weight, greater absorptiveness, etc.) are also in their favour. Both cobs and stalks were much less effective when used without any bran.

In cage experiments with possible substitutes for arsenicals in grasshopper baits, magnesium sulphate proved to be ineffective. Baits containing 3 and 5 per cent. sodium fluosilicate in a pure maize-stalk base both killed 89 per cent. of the grasshoppers.

Donaldson (F. T.) & Welch (H.). **Does Grasshopper and Cricket Control Work involve Hazards to Livestock?**—*Bull. Montana agric. Exp. Sta.* no. 351, 7 pp., 2 refs. Bozeman, Mont., January 1938. [Recd. July 1938.]

The increased use of arsenicals for the control of grasshoppers and the Mormon cricket [*Anabrus simplex*, Hald.] in Montana during the last few years has led to many requests for information regarding the risks involved in feeding animals on crops from treated fields. Many suspected feed samples have therefore been analysed for arsenic. Tables show the amounts of arsenic trioxide present in various samples, and the weight of fodder containing a dose injurious to a horse or a cow. The authors conclude that the use of grasshopper bait does not endanger livestock if the bait is spread correctly and care is exercised in storing or discarding unused portions; and that there appears to be no danger in feeding animals on crops from fields dusted with sodium arsenite for the control of *A. simplex*, provided that the dusting is done in accordance with recommended practices.

Batten (E. T.) & Poos (F. W.). **Spraying and Dusting to control the Potato Leafhopper on Peanuts in Virginia.**—*Bull. Virginia agric. Exp. Sta.* no. 316, 26 pp., 9 figs., 3 refs. Blacksburg, Va, April 1938.

The following is largely taken from the authors' summary: *Empoasca fabae*, Harr., is probably the most serious insect pest of ground-nuts in Virginia, where this crop is very important. It does not overwinter there, but comes north from the Gulf States every spring, appearing in southern Virginia in late April or early May. The eggs are deposited in the petioles or larger veins of the leaves, where they usually hatch in 4–9 days in the summer. Under optimum conditions, the life-cycle is completed in about 3 weeks. The leafhopper is often very abundant during July and August. It feeds on the leaves and petioles, often causing scorching of the tips and margins of the leaves, and yellowing and dwarfing of the foliage.

Experiments carried out from 1932 to 1937, inclusive, indicated that 3 applications of a spray of Bordeaux mixture (4 : 4 : 50) gave remarkable increases in yields of ground-nuts [*R.A.E.*, A **25** 697]. In addition to the Bordeaux mixture, which was applied as a dust as well as a spray, copper carbonate and copper phosphate were tested as sprays, and sulphur and pyrethrum-sulphur as dusts. The results

showed that either Bordeaux mixture applied as a spray, or sulphur applied as a dust, produced very profitable increases in yields of both field-cured ground-nuts and ground-nut-vine hay. Shelling tests showed no significant differences in the weight of individual nuts and in the number of nuts per pod between samples from the treated and untreated plots.

On the basis of these results, three applications of Bordeaux mixture as a spray, or of sulphur as a dust, are recommended, the first about 10th–15th July, and the second and third at intervals of approximately 21 days. Directions are given for applying these materials, and the effects of weather, soil and other factors involved in the treating of the ground-nut crop are discussed.

CRAUFURD-BENSON (H. J.). **The Selection of a standard Insect for the Laboratory Testing of Insecticides.**—*Bull. ent. Res.* **29** pt. 2 pp. 119–123, 7 refs. London, July 1938.

The following is substantially the author's summary : The standards adopted by the author for a test insect suitable for the laboratory testing of insecticides [*cf. R.A.E.*, A **26** 405] are given. The inadvisability of using insects collected in the field, or insects that do not breed naturally throughout the year, is illustrated. A table is given showing the susceptibility of 27 species of stored-product insects to a derris insecticide. *Ahasverus advena*, Waltl, *Oryzaephilus surinamensis*, L., and *O. mercator*, Fauv., have been found to be suitable laboratory test insects.

FERRIÈRE (Ch.). **Descriptions of some African Eulophidae (Hym. Chalc.).**—*Bull. ent. Res.* **29** pt. 2 pp. 141–147, 5 figs. London, July 1938.

Descriptions are given of both sexes of five new species of Eulophids and of *Entedon perturbatus*, Wlk., which is recorded as a parasite of Bruchids in South Africa, Southern Rhodesia, and Tanganyika, and, from a Bruchid imported from India, in Uganda. The new species are : *Dimmockia kampalana*, reared from a Pyralid attacking coffee beans, and *Cassidocida africana* and *Aprostocetus aspidomorphae*, which was possibly a hyperparasite, bred together from eggs of *Aspidomorpha tecta*, Boh., all in Uganda ; *Entedon apionidis*, from *Apion xanthostylum*, Wagn., on cotton in Tanganyika ; and *Thripobius* (gen. n.) *hirticornis* from *Retithrips aegyptiacus*, Marchal, in Tanganyika, and *R. syriacus*, Mayet, in the Gold Coast.

KNECHTEL (W. K.). **Ueber die Wanderheuschrecke in Rumänien.**—*Bull. ent. Res.* **29** pt. 2 pp. 175–183, 1 map, 2 plates, 14 refs. London, July 1938.

A brief history is given of outbreaks of *Locusta migratoria*, L., in Rumania from 1538 onwards, and the one that occurred in 1927–33 is described in greater detail. There are three main permanent breeding areas of this locust, all of them confined to the few and limited sandy areas in the Danube delta, which is mostly overgrown by dense reeds. Hoppers hatching there wander into the reeds, swimming across the water that they encounter. In one case, hoppers were carried for over 7 miles by the current and eventually landed on the opposite shore of the river.

Normally, most of the sandy areas in the delta are flooded in spring and they may remain under water for as long as 3½ months. If the flood recedes before the middle of May, the eggs will hatch, but a longer submergence is fatal to them. Prior to the last outbreak, the spring floods were low and many sandy areas remained above water. Flooding of numerous areas was prevented, since the banks of channels were raised in the delta. Thus, new uncultivated areas were drained and formed suitable sites for breeding. The result was a great increase of swarms followed by their migration beyond the limits of the delta. The damage caused by these locusts was, however, small as they fed mostly on reeds. The few cultivated fields in the delta were saved by digging trenches and burning the hoppers caught in them by means of flame-throwers. Other methods of control included the use of iron barriers, poison baits and arsenical sprays.

A permanent observation post has been recently established on the Danube delta in order to keep the breeding areas under constant supervision.

Vesey-FitzGerald (D.). **Biological Notes on some Coccinellidae from East Africa.**—*Bull. ent. Res.* **29** pt. 2 pp. 185–189. London, July 1938.

In the latter half of 1936, a search was undertaken in the coastal regions of Tanganyika Territory, including the Islands of Zanzibar and Mafia, for predators and parasites that might be of use against certain Coccids injurious to coconuts in the Seychelles. Scale insects were very scarce on coconuts in East Africa, and bamboo (*Bambusa vulgaris*) was the only plant frequently infested. The Coccinellids found were predacious on a wide variety of scales on different plants, but they can be broadly divided into 4 principal groups, predacious, respectively, on Diaspidinae, Lecaniinae and Eriococcinae, Monophlebinae, and Aphids. Two other groups were composed of feeders on fungus mycelium and plants. Correlated with these divisions, colour pattern resemblances among the species were detected, which, considering the distasteful nature of the beetles, and the frequent association of species with the same geographical range and food requirements, might be regarded as a case of Müllerian mimicry. There was also a tendency for members of a certain food group, but with a different distribution, to have a different colour pattern. These pattern characteristics were found to be a useful guide to the food requirements of fresh species collected by random methods.

The colour patterns of the different groups are briefly outlined with records of the species in them, and a list is given of the species collected, showing their prey or food, the plants on which they were taken, and the localities and types of country in which they occurred.

Trägårdh (I.) & Butovitsch (V.). **Some Forest Entomological Methods and Conceptions.**—*Bull. ent. Res.* **29** pt. 2 pp. 191–210, 11 figs., 11 refs. London, July 1938.

In this paper on the methods used to estimate the population of bark beetles in Swedish forests after severe storms in 1931–32 [*R.A.E.*, A **23** 222], the author discusses in detail strip surveys [**23** 405], the analysis of the fauna of trap logs or standing trees [**15** 271 ; **18** 317], and a formula by which the necessary number of trap logs may be

calculated. This formula entails a knowledge of the number of beetles to be trapped in a certain area, their mortality rate at different seasons, and the total area of suitable bark provided by the trap.

MARSHALL (Sir G. A. K.). **Three new injurious Curculionidae (Col.).**—*Bull. ent. Res.* **29** pt. 2 pp. 211–213. London, July 1938.

The new species described are : *Protostrophus dianthi*, on carnation leaves in Cape Province ; *Pantomorus inimicus*, a serious pest of apple trees in Brazil ; and *Paraplesius ugandanus*, on the leaves of tea in Uganda.

MASSEE (A. M.). **Notes on some interesting Insects observed on Fruit Trees in 1937.**—*Rep. E. Malling Res. Sta.* 1937 **25** pp. 203–208, 1 pl., 2 refs. East Malling, Kent, May 1938.

Insects observed on fruit trees in south-eastern England in 1937 included larvae of *Sinodendron cylindricum*, L., which severely infested the trunks of cherry trees in an orchard in Kent. The larvae of this Lucanid commonly occur in the trunks of various woodland trees, particularly those that are unhealthy, or even in rotten logs. In the latter part of June, adults of *Crepidodera* (*Derocrepis*) *rufipes*, L., were very abundant in one locality, feeding on the young leaves at the tips of new growths of apple ; this flea-beetle is generally found on mallow [*Malva*] and some leguminous plants. *Chaetocnema concinna*, Marsh., was very numerous on strawberry, attacking the epidermis of the upper surface of the younger leaves.

Adults of *Cydia pomonella*, L., which is usually considered to have only one generation a year in England, were present from May to October. The long flight-period suggested that some of the moths belonged to a summer brood, a view supported by the fact that pupae as well as hibernating larvae were found in bands on apple trees in October, and adults emerged from some of them during the second week in October. In 1936 and 1937, *Tortrix* (*Cacoecia*) *podana*, Scop., caused damage to apples in the field, and was particularly injurious in the packing sheds [*cf. R.A.E.*, A **23** 126]. Small larvae are brought into the sheds with the fruit and many remain with the apples while they are being graded and wrapped. A few were still feeding in December, and in one box about 50 per cent. of the fruit had been damaged. Injury never occurred under conditions of gas storage. At the beginning of June, larvae of *Coleophora* (*Eupista*) *nigricella*, Steph., which generally feed on the leaves of apple and plum, pierced the skins and fed on the flesh of sour and sweet cherries, making tunnels about an eighth of an inch deep, and caused the injured fruits to split as they matured. The second brood of *Anthophila pariana*, Clerck, was more common than usual on apple in many parts of Kent. The larvae do not cause much damage to the foliage of established trees, but infestation of bush trees 2–3 years old is sometimes serious. The adults were very plentiful in the autumn, and in December hundreds were found hibernating in a haystack. Larvae of *Dicranura* (*Cerura*) *vinula*, L., which usually feed on poplar and willow, were found on apple foliage, on which they were successfully reared. *Dasyneura tetensi*, Rübs., which infests blackcurrant and was first recorded in Kent about 5 years ago, was very prevalent in parts of Kent, Hampshire and Cambridgeshire in 1937. The larvae live in the

leaves and cause characteristic deformation to the growing points of the shoots. In December, pears in one district were infested with the large willow Aphid, *Lachnus* (*Pterochlorus*) *salignus*, Gmel. ; most of the Aphids present were winged. Larvae of *Acronicta rumicis*, L., and *A. psi*, L., which are not considered to be of economic importance, were observed on apple, bush fruits and other plants, and those of *Gastropacha quercifolia*, L., which is usually rather scarce, on apple. Larvae of this Lasiocampid sometimes feed on the young leaves of apple, but buds of one year's growth were attacked in one orchard, and considerable damage resulted.

Partly decayed hop roots received from Worcestershire in July were infested by larvae of *Epipolaeus caliginosus*, F., which had tunnelled into them for 6 inches or more ; some apparently healthy roots were also infested. The adult weevils emerged in early August ; they usually hide under stones and in moss during the day, and are active at dusk and during the night.

Massee (A. M.), Greenslade (R. M.) & Duarte (A. J.). **Notes on the Strawberry Aphid** (*Capitophorus fragariae* **Theob.**).—*Rep. E. Malling Res. Sta.* 1937 **25** pp. 209–212, 1 fig., 1 ref. East Malling, Kent, May 1938.

Much of the information in this account of the bionomics of *Capitophorus fragariae*, Theo., on strawberry in Kent is similar to that already noticed [*R.A.E.*, A **26** 103]. In 1937, alates appeared at the end of May, and the spring migration lasted for only a week. Winged Aphids were also present from late September to the end of November, but no migration took place, possibly on account of the unfavourable weather conditions. Apterous forms moved freely from plant to plant at most seasons of the year. From May to October, wild plants that might possibly serve as alternative food-plants were carefully examined, and colonies of the Aphid were found on *Potentilla anserina*.

Massee (A. M.), Greenslade (R. M.) & Duarte (A. J.). **Studies of impregnated Tree Banding Materials. IV. Apple Blossom Weevil and Codling Moth Experiments in 1937.**—*Rep. E. Malling Res. Sta.* 1937 **25** pp. 213–218, 1 ref. East Malling, Kent, May 1938.

Further experiments are described on the use of bands of corrugated cardboard impregnated with beta-naphthol, 2 types of chlorinated naphthalene (Seekay waxes) or tetrachlorobenzene for the control of *Anthonomus pomorum*, L., and *Cydia pomonella*, L., on apple in Kent [*cf. R.A.E.*, A **25** 666, etc.]. The results, which were somewhat inconclusive, showed that the only 2-inch bands that caught significantly more larvae of *A. pomorum* and *C. pomonella* than untreated ones were those treated with 20 oz. tetrachlorobenzene and 10 oz. of one of the Seekay waxes per 100 ft., respectively, and that beta-napthol repelled the former. Comparisons of the catches with 2 and 4-inch bands also gave inconclusive results.

Shaw (H.) & Steer (W.). **Spray Residue Investigations. II. The Influence of Spray Supplements on the Retention of Lead Arsenate on Apples.**—*Rep. E. Malling Res. Sta.* 1937 **25** pp. 219-222, 7 refs. East Malling, Kent, May 1938.

Recent work on the control of *Cydia pomonella*, L., on apple in Kent [*R.A.E.*, A **25** 667 ; **24** 742] has shown that a late June spray

of lead arsenate is desirable, but that applications after this are likely to leave a residue that will exceed the tolerance limit (0·01 gr. As_2O_3 per lb.) at harvest [**25** 666]. The investigation here described was carried out in 1937 to test the current beliefs that the addition of lime-sulphur would increase the sticking power of the lead arsenate, that a wetting agent would give a more even but less heavy deposit, and that the addition of oil would increase both the initial deposit and its persistence. The materials used were: lead arsenate paste containing 15-16 per cent. arsenic pentoxide, at 0·4 per cent.; lime-sulphur solution, specific gravity 1·3, polysulphide sulphur (by weight) approximately 20 per cent., at 0·75 per cent.; lethalate wetting preparation, at 0·05 per cent.; and Shell oil 24413, emulsified with sulphite lye [**21** 556], at 1 per cent. oil. Applications were made as uniformly as possible with a moderately fine spray on 20th June. After the sprays had dried, it was observed that lead arsenate alone gave a heavy but uneven and patchy deposit; with lime-sulphur, it gave a deposit almost as heavy but more even; with lethalate, it gave a more even but lighter deposit, and most of the spray ran off the upper surface of the fruit and accumulated on the lower surface; and with oil, it gave the most uneven deposit, which was concentrated particularly where leaves, or leaves and fruit, were in contact. The scorching and falling of the leaves during the fortnight after spraying were most pronounced where lime-sulphur or oil had been included in the spray, but none of the damage was severe. None of the sprays influenced the size of the fruit at any stage.

The residues of As_2O_3 in parts per million on the fruit on 15th July and 5th and 23rd August were, respectively, 3·20, 2·805 and 1·575 after lead arsenate and oil, and 2·51, 1·445 and 0·77 after lead arsenate alone, the significant difference between any two treatments being 0·49. There was no significant difference between the residues for lead arsenate alone and for the three other sprays, in which it was mixed with lime-sulphur, lethalate or both.

On 1st October, after the crop had been picked, visual inspection showed the white residue to be most conspicuous on fruit sprayed with lead arsenate and oil, and noticeable wherever lime-sulphur had been used. Scarcely any trace remained on fruits that had been sprayed with lead arsenate alone or mixed with lethalate only. The residue after lead arsenate and oil was even more marked on the leaves. By 23rd August even the heaviest deposit of this spray was little above the tolerated maximum, and it would, undoubtedly, be below this on fruit picked in late September, but the visible deposit on the picked fruit was too conspicuous to be ignored.

Steer (W.) & Hassan (A. A. G.). **Experiments in the Control of Plum Sawfly on Czar Plums.**—*Rep. E. Malling Res. Sta.* 1937 **25** pp. 223–228, 6 refs. East Malling, Kent, May 1938.

Spraying tests for the control of *Hoplocampa flava*, L., on plum were carried out in Kent in 1936 and 1937 to determine the effect of applications of derris and other insecticides, with different wetters, in either early or late sprays or both. The derris was a proprietary brand of ground root yielding 10·4 per cent. ether extract, 2·73 per cent. crude rotenone, and 2·14 per cent. crystalline rotenone, and was used at the rate of 2 lb. per 100 gals. (0·2 per cent.). In 1936, it was compared with nicotine, 95–98 per cent. pure, used at the rate

of 8 oz. per 100 gals. Lethalate (8 oz. per 100 gals.) was used with both the derris and the nicotine; it contained 75 per cent. commercial sodium lauryl sulphate, 20 per cent. alkali salts of di-isopropyl naphthalene sulphonic acids, and 5 per cent. natural gum. The sprays were applied on 14th May when most of the petals had fallen and many of the fruitlets were quite free of the cot, and no sawfly larvae could be found. The percentages infested on 4th and 6th June were 4·9 and 27·2, respectively, on trees sprayed with derris and nicotine, and 22·4 on the controls.

In 1937, a soap prepared by dissolving 3 oz. sodium hydroxide in 50 gals. water, and then adding 1 pint commercial brown oleine, was mixed with derris spray. On 14th May, not more than 80 per cent. of the petals had fallen, and a great many of the cots were beginning to split; no adult sawflies or larvae were found. No larvae were found on 22nd May, but on 29th infestation was well advanced on the unsprayed trees. When the fruits were examined on 9th June, the percentages infested on plots sprayed with derris and soap on 14th or 22nd May, on both dates, and on the controls were, respectively, 5·0, 1·6, 0·04 and 35·4. In another orchard, sprays were applied on 17th May, 3 days after the first newly hatched larva had been found. The percentage infestations on 4th–5th June were: 4·6 with derris and soap; 13·7 with a 0·1 per cent. solution of thiodiphenylamine (93 per cent. pure) and soap; 27·5 with a lead arsenate paste at 0·4 per cent.; and 36·0 in the controls, the significant difference being 8·6. A spray of derris, 1 lb. per 100 gals., and soap, applied at the same time, reduced infestation from 30·3 to 5·6 per cent., the significant difference being 15·7. Crop records showed that derris increased the crop by about 28 per cent., although there was a heavy set of plums on all the trees.

The results suggest that one application of derris gives substantially as good results as two, and that sprays of derris and soap can be successfully applied at any time during the 7–10 days following petal fall, an important consideration where a large acreage has to be sprayed. The authors conclude that until satisfactory extracts of quassia are readily available it is unlikely to replace derris for the control of *H. flava* [*cf. R.A.E.*, A **26** 191].

WATSON (M. A.). **Aphis Transmission of some Plant Viruses.**—*Proc. roy. Soc.* (B) **125** no. 840 pp. 305–307. London, 16th June 1938.

Tests have been made to determine whether the effect of preliminary starvation of an Aphid in increasing the efficiency with which it transmits virus, observed in the case of *Hyoscyamus* virus 3 (Hy 3) and *Myzus persicae*, Sulz. [*R.A.E.*, A **26** 342], could be demonstrated for other viruses and vectors. The viruses used were two strains of Hy 3 virus, one of which has not been previously described, one strain of potato virus Y, and two strains of cucumber mosaic virus. All were transmitted, with varying degrees of success, by *M. persicae* and *M. circumflexus*, Buckt. *M. persicae* was a much more efficient vector than *M. circumflexus* for the Hy 3 viruses and potato virus Y, though both responded proportionally to the preliminary fasting treatments. With the cucumber viruses, both species were less successful, but *M. circumflexus* was at least as good a vector as *M. persicae* and probably a better one. There was a good response to preliminary starving, but, in the case of *M. persicae*, the optimum feeding time on the infected

plant was longer than for the other viruses. Within the two groups of viruses, though not between them, there appeared to be some relationship between the infectivity of the viruses as determined by the starch lesion count method and their transmissibility by the vectors.

Cahn (R. S.), Phipers (R. F.) & Boam (J. J.). **The Action of Alkali on Rotenone and related Substances.**—*J. chem. Soc.* 1938 pp. 513–536, 7 figs., 1 ref. London, April 1938. **The Methylation and Ease of Ring-fission of Rotenone and related Substances.**—*T.c.* pp. 734–741. London, May 1938. **The total Composition of Derris Extract.**—*J. Soc. chem. Ind.* **57** no. 6 pp. 200–209, 1 fig., 31 refs. London, June 1938.

The first two papers give accounts of recent investigations on rotenone and similar substances in the elucidation of the chemistry of derris. The results and those of other workers are given briefly in the third paper, from the summary of which the following is taken: It has been known for some time that the resin to which derris root owes its insecticidal value contains laevorotatory rotenone and sumatrol and that treatment with alkali yields optically inactive toxicarol and deguelin. Recently proof has been obtained that the toxicarol precursor isolated by F. Tattersfield and J. T. Martin is a mixture of *l*-toxicarol and a little sumatrol. The extremely mild alkaline conditions that racemise rotenone and similar substances suffice to liberate *dl*-deguelin from the resin and to convert the *l*-toxicarol present into a *dl*-compound. This and other evidence strongly confirms the view that deguelin exists in the resin as the *l*-form. The variations of commercial derris root are discussed, and it is shown that a continuous range of types exists. Methods of estimating deguelin, toxicarol with sumatrol, and fats or waxes in derris are described, and the determination of rotenone is discussed; in this way 82–90 per cent. of the total ingredients of the extract are quantitatively accounted for.

In a section on some aspects of the biological testing of insecticides, it is stated that Tattersfield and Martin thought their toxicarol precursor to be toxic to *Aphis rumicis*, L., though much less so than rotenone. Tests on *Ahasverus advena*, Waltl, by H. J. Craufurd-Benson, showed that a similar impure toxicarol precursor obtained by the authors was also toxic, but that pure *l*-toxicarol was not; the toxicity of sumatrol was approximately equal to that of rotenone, and it had been found to be toxic to larvae of winter moth [*Operophtera brumata*, L.] by two of the authors. The effect of the physical state of insecticides on their apparent toxicities is stressed in the light of new examples. Derris extract, tested in suspensions prepared by dissolving it in an organic solvent and adding to an aqueous solution of a wetting agent, was highly toxic to *A. advena*, but similarly prepared suspensions of rotenone were completely ineffective. This was surprising, as rotenone is more toxic to all other test insects than is the whole extract weight for weight; also the toxicity of an extract to *A. advena* was increased by adding rotenone to its solution in the organic solvent before dilution. The failure of suspensions of rotenone alone was undoubtedly due to its tendency to form relatively large crystalline aggregates, whereas the extract largely remains as distinct amorphous particles, though no difference was detected even under the microscope, and the rates of flocculation

did not differ appreciably. In criticising results of investigations [*R.A.E.*, A **24** 729] according to which a given amount of *l*-dihydrodeguelin was as toxic to mosquito larvae as 10 times its weight of the *dl*-compound, the senior author has stated that the maximum possible theoretical ratio is 1 : 2, since the *dl*-compound contains half its weight of the *l*-compound, and the most likely explanation of the larger ratio lies in the differing physical states of the suspensions used.

[Rusanova (V. N.).] **Русанова (В. Н.). *Phragmites communis* (L.) as a Place of Reservation of the Swedish Fly *Oscinella frit* L.** [*In Russian.*]—*Trud. Azerbaij. Fil. Akad. Nauk USSR* **7** (Sekt. Zool.) pp. 140–146, 9 refs. Baku, 1934. (With a Summary in English.) [Recd. July 1938.]

In 1928 and 1929, *Oscinella frit*, L., was found to be abundant on wheat and barley in a district in central Azerbaijan, where it had been thought that the climate was too hot and dry to be favourable for it. Investigations were therefore made to determine the plants on which it breeds during the hot period when cereals are not available. It was found that most of the grasses near infested fields dry up and are not suitable for oviposition when the adults are on the wing. Larvae of different instars and pupae were, however, found in the stems of the reed, *Phragmites communis*, which grew along irrigation ditches and in swamps adjoining the fields. In most cases, the infested stems were perforated, probably by the exit holes of some large larvae, and the flies had penetrated into the reeds through these holes and oviposited in them. These findings were confirmed by observations in the summer of 1930 in another district, when larvae and pupae of *O. frit* were again found in the stalks of *P. communis* adjoining cultivated fields of barley and wheat.

[Moroshkina (O. S.).] **Морошкина (О. С.). The Kouzka Beetle (*Anisoplia austriaca* Hrbst.), its Injuriousness and Means of Control.** [*In Russian.*]—[*Publ.*] *Rostov obl. opuitn. Sta. Polevod.* (N) no. 7, 72 pp., 3 graphs, 3 diagr., 5 figs., 52 refs. Rostov-on-Don, 1938. (With a Summary in English.)

Experiments were carried out in 1934–36 in several localities in the Azov-Black Sea region on agricultural methods for the control of the Rutelid, *Anisoplia austriaca*, Hbst., the adults of which cause severe damage to cereals there and in northern Caucasus. Its life-cycle is completed in two years, and adults appear every second year. The larvae, which overwinter in the soil at a depth of 8–12 ins., feed on organic matter and the roots of cereals. They pupate at the beginning of June, and the pupal stage, which lasts about 20 days, is passed in earthen cells, usually at a depth of 2–6 ins. The majority of the adults emerge early in July. They first feed on autumn-sown wheat, but as the grains in the ears harden, they migrate to spring-sown wheat, which is then in the stage of milky ripeness. The loss in grain due to feeding by the adults in 1934 amounted to 10·4 per cent. in some localities. Autumn-sown wheat suffers most, as the mass emergence of the adults coincides with the phase of milky ripeness. The greatest numbers of beetles occur on the plants during hot weather. The eggs are deposited in the soil at a depth of 4–8 ins., the first in 1925 being observed on 10th July. The larvae hatch in early August and begin to hibernate in the second half of November.

Cultural methods of control include ploughing in mid-April and again at the beginning of June to a depth of 6 ins. and subsequently harrowing to destroy mature larvae and pupae directly and by exposure. Too early ploughing is ineffective, as the larvae exposed burrow quickly into the soil. Ploughing wheat stubble at the end of July to a depth of not less than 8 ins. exposes the eggs, which dry up, and deep ploughing in November at the onset of frosts to a minimum depth of 12 ins. destroys hibernating larvae. Observations showed that wheat sown at the end of March or beginning of April was considerably less damaged by the beetles than that sown on 23rd or 27th April. It was also found that the loss in grain was reduced by two-thirds by cutting the wheat early, at the time of waxy ripeness. Severely infested plots should therefore be harvested first. Crop rotation reduced infestation. Observations on the larvae showed that they move very little in the soil, that they feed on the rootlets of wheat plants, causing them to wither, and that they can thrive in the absence of plants, if the soil contains decomposing organic matter for them to feed on.

[Gilyarov (M. S.) & Luk'yanovich (L. M.).] **Гиляров (М. С.) и Лукьянович (Л. М.). The Insect Pests of the Seeds of** *Taraxacum kok-saghyz* **Rod. and other Rubber-producing Plants.** [*In Russian.*] —*Pests & Dis. Rubber-prod. Plants* (Ser. Art. 2) pp. 22–48, 5 figs., 12 refs. Moscow, ONTI, 1938. (With a Summary in English.)

Records are given of 33 species of insects that feed on the seeds, flowers or capitula of the rubber-producing plants, *Taraxacum kok-saghyz* and *T. megalorrhizon* in the Ukraine, with a key to the 13 that attack the seeds (based on the character of the damage and the morphology of the larvae or pupae) and notes on the bionomics of some of them.

The only injury of economic importance is that caused to the seeds of *T. kok-saghyz* by Trypetids. Of these, *Ensina sonchi*, L., an outbreak of which occurred in 1934 when the weather was hot and dry, is the most injurious. Its mode of hibernation has not been ascertained, but it is suggested that the adults overwinter in sheltered places. The fact that comparatively few Compositae are infested in the spring indicates that only a small percentage of adults survives the winter. The marked increase of the infestation towards the end of the summer is due to the great fecundity and short life-cycle of the fly. As many as 10–12 overlapping generations occurred in central Ukraine in 1934. The adults live for over 20 days, and eggs are laid in capitula of different degrees of maturity, chiefly in buds about to open. Oviposition continues throughout the life of the female, which may infest over 17 capitula in a day. The larvae hatch in 3–4 days and feed on the seeds ; in the course of its life a larva thus destroys about ten seeds and injures about ten more. Under laboratory conditions, the larval and pupal stages lasted 14 days each at 14–16°C. [57·2–60·8°F.] and 3–5 and 4–5 days, respectively, at 23°C. [73·4°F.]. Pupation takes place in the capitula, which usually harbour only 1 or 2 pupae, though sometimes as many as 5–6 are found. Of the different species of Compositae, those with large capitula are more readily infested. *Sonchus arvensis* is especially important, since owing to its abundance it acts as a reservoir of infestation. In the case of *T. kok-saghyz*, the chief damage is caused to plants of the first year of vegetation, which flower in the second half of summer when the overwintered

adults have given rise to new generations. This Trypetid was parasitised by two unidentified Chalcidoids and a Braconid, the adults of which emerged from parasitised puparia 20 days after the flies from normal ones.

Next in importance is *Paroxyna tessellata*, Lw., which resembles *E. sonchi* in its life-history, but has only 3–6 generations a year in central Ukraine. In the cold and rainy summer of 1933, the larval and pupal stages lasted about 13 and 22 days, respectively; at an average temperature of 23°C., the latter lasted 9–11 days. In the autumn, about 75 per cent. of the pupal cases contained Hymenopterous parasites. Of the wild Compositae, *Hieracium* spp. were preferred; *S. arvensis* was not attacked. *Trypanea stellata*, Fuessly, caused considerable damage to the seeds of *Taraxacum kok-saghyz* in 1933. In June the larval and pupal stages lasted 12 and 17 days, respectively. All the pupal cases found in autumn were parasitised by Chalcidoids, and infestation by this Trypetid was slight in 1934.

Control measures against these Trypetids include the destruction of wild Compositae, particularly *S. arvensis*, and cultivating plots of *Taraxacum* among other crops. As the flies do not rise high in the air, strips of tall plants round fields of *Taraxacum* would give protection. Good control of adults of *E. sonchi* was obtained in small scale field experiments by a bait-spray containing 10 per cent. honey and 0·5 per cent. sodium arsenite. Spraying plants on 4 consecutive days at the beginning of September reduced the percentage infestation of capitula of *T. megalorrhizon* and *T. kok-saghyz* 9 days later from 50 and 22 to 18 and 0, respectively, and the plants were not scorched. When molasses was substituted for honey, the adults were not attracted.

Bréjoux (D.). **L'utilisation de microbes pathogènes dans la lutte contre la pyrale, l'eudémis et la cochylis.**—*Agric. prat.* N.S. **102** no. 2 pp. 56–57. Paris, 1938. (Abstr. in *Rev. appl. Mycol.* **17** pt. 6 p. 393. Kew, June 1938.)

In the course of a brief survey of the system of combating vine moths by spraying the vines with suspensions of spores of pathogenic bacteria [*R.A.E.*, A **25** 795] at the rate of 1 oz. to 6¼ gals., figures are cited illustrating the results of tests on these lines made by [S.] Metalnikov for the control of *Polychrosis botrana*, Schiff., on vines in various parts of France. In one locality, 5,224 grapes on 100 control bunches and 416 on 100 treated bunches were infested; and the yield of a chemically treated plot was less than half that of a similar plot treated with bacterial spores. In another district there were 16,350 grapes attacked in the control plot and only 1,884 in the sprayed one. With other data of a comparable order, these results indicate an efficiency of 90 per cent. for the method.

Klee (H.). **Zur Kenntnis der Weizengallmücken** *Contarinia tritici* **Kirby und** *Sitodiplosis mosellana* **Géhin** (*aurantiaca* **Wagner**). [A Contribution to the Knowledge of the Wheat Gall-midges, *C. tritici* and *S. mosellana*.]—Inaug. Dissertation Univ. Kiel 102 pp., 7 pls., 16 pp. refs. Kiel, 1936. [Recd. 1938.]

This thesis on *Contarinia tritici*, Kby., and *Sitodiplosis mosellana*, Géh., infesting wheat, is based on investigations made in 1929–31 on

the island of Fehmarn, off the coast of Schleswig-Holstein, where they cause losses of up to 30 per cent. of the crop. An account is given of the synonymy, morphology, distribution and ecology of both species, with records of infestation and notes on the injury they cause to the ears of wheat. The salient points of their life-history, as summarised by the author, are very similar to those recorded from Sweden [*R.A.E.*, A **23** 625; **26** 230, etc.] and much of the information on control has already been noticed from other papers by the author [**23** 123, etc.].

The principal parasites reared on Fehmarn were the Scelionids, *Isostasius punctiger*, Nees, which oviposits in the eggs of *C. tritici*, and *Leptacis tipulae*, Kby., which oviposits in the larvae of both the Cecidomyiids [*cf.* **26** 231], but the percentage parasitism was very low. Other parasites and predators are recorded from the literature.

Rozsypal (J.). **Einige Beiträge zur Kenntnis des Blattrippenstechers.** [A few Contributions to the Knowledge of *Rhynchites pauxillus*.]—*Folia ent.* **1** fasc. 1 pp. 75–86, 1 graph, 4 figs. Brno, 1938.

Outbreaks of *Rhynchites pauxillus*, Germ., occurred in Moravia in 1931 and 1935, when it caused considerable damage to apples and also attacked pears. An account is given of its bionomics as observed in orchards and in the laboratory [*cf. R.A.E.*, A **25** 386]. Hibernation occurs chiefly in the adult stage, but larvae that hatch in autumn may pass the winter as larvae or pupae. The overwintered weevils are sexually immature when they appear on apple trees in April, and feed first on the unopened buds and then on the young leaves and shoots. Oviposition begins, 3–14 days after pairing, in the first half of May, and reaches its maximum intensity after a week or two. The female usually lays 1–4 eggs in the central vein on the lower side of the leaf, and then gnaws the stalk where it joins the leaf, which causes the latter to wither and fall in about a week. The oviposition period lasted about 2 months in captivity and about 4 months in the orchards. On an average, a female lays 4 eggs daily during the period of intense oviposition, which lasts 7–14 days. Before and after this period, it lays from 1 to 5 eggs in a day at intervals of 1–4 days. In captivity, the total number of eggs laid by individual females in the course of two months ending 11th July varied from 32 to 92. The average duration of the egg stage was 7 days in the orchard in spring and 5 in the laboratory at 20–21°C. [68–69·8°F.]. At first the young larvae feed on the tissues immediately surrounding the cavity occupied by the egg, and later, when the leaves drop, they mine in the blade, thus feeding on dead and dry tissues. The larvae mature in about 4 weeks and pupate in the soil at a depth of about 2 ins. The pupal stage lasts about 4 weeks in summer and longer in autumn. The life-cycle from egg to adult is completed in 77–86 days, and the first young weevils resultant from eggs laid in the second half of May appear in mid-August. Since intensive oviposition lasts till mid-June, many adults continue to emerge till the end of September; they feed on the leaves, but the damage caused at this time is negligible. In the laboratory, larvae that hatched from eggs collected in mid-June pupated at the beginning of October, and only a few of the pupae gave rise to adults in the same year. Of larvae obtained from eggs laid in the beginning of September, some hibernated as pupae and others as larvae; they became adults late in the following spring.

The chief damage is due to the maturation feeding of the weevils in spring and to the premature shedding of the foliage. The infested trees yield fewer fruits and the development of the wood is reduced. Jarring the weevils on to sheets is the best means of control [*cf.* **21** 634]. It is also worth while to rake up and destroy fallen leaves containing the larvae, but the application of stomach insecticides is of limited value, as the adults feed on the inner parts of the buds or on the lower surface of young leaves.

Fransen (J. J.). **De plagen van de dennenbladwesp,** *Diprion* (*Lophyrus*) *pini*, **L.** [The Outbreaks of the Pine Sawfly, *D. pini*.] —*Landbouwk. Tijdschr.* **50** no. 609–610 repr. 27 pp., 2 figs., 5 graphs, 3 maps, 36 refs. Wageningen, 1938. (With a Summary in German.).

The author has sought to elucidate the reasons for the irregular and unexpected outbreaks of *Diprion pini*, L., which cause much injury to pines in Holland, and here summarises available knowledge on the subject.

The basic cause of outbreaks in western Europe and especially Holland is the planting of pines in unmixed stands. Natural enemies are unable to control them if other conditions are favourable. The sawfly has two generations a year, and in each there are two periods, separated by about three weeks, in which the females appear. There are therefore four periods in which first-instar larvae, which are highly sensitive to heavy rain, occur. It is maintained that an outbreak may be expected if hail and heavy rain do not occur shortly after all four oviposition periods. The local distribution of outbreaks in Holland is discussed. Experiments showed that larvae from pines in a given locality could be bred on pine twigs from other parts of the country, some being of varieties of pine different from the original one.

Fransen (J. J.). **Het opsporen van** *D. pini* **-plagen.** [The Detection of probable Outbreaks of *D. pini*.]—*Tijdschr. ned. Heidemaatsch.* **50** pt. 4 pp. 119–125, 2 figs. [Utrecht], April 1938.

Information is given to enable forest workers in Holland to ascertain the date on which a dust insecticide should be applied in pine forests against *Diprion pini*, L., and whether the infestation is such as to require control. Cocoons should be collected and examined in January, February or early March. The various changes that occur in the colour and size of the eyes and in the shape and development of the body, as the development of the prepupa progresses, are described and illustrated. About a week before pupation, the eyes and appendages of the adult sawfly are developed. The pupal stage lasts 9–10 days. Adult emergence occurs over some months, but there are two main periods, which are those of practical importance. The cocoons of the next generation should be examined in the same way as overwintered cocoons. The eggs are not readily recognisable by unexperienced persons, and should be carefully examined to acquire a knowledge of their appearance. They can be obtained for this purpose by confining some newly emerged adults in a wide-mouthed bottle having a layer of earth at the bottom in which pine twigs with one-year-old needles are stood. The mouth of the bottle should be closed with gauze.

Judenko (E.). **Studies on the Corn-borer** (*Pyrausta nubilalis* **Hbn.**) **in Connection with the Infestation of Hops** (*Humulus lupulus* **Lin.**) **and Millet** (*Panicum miliaceum* **Lin.**). [*In Polish.*]—*Prace Wydz. Chor. Szkodn. Rośl. państw. Inst. nauk. Gosp. wiejsk. Bydgoszczy* no. 17 pp. 19–122, 3 pls., 67 refs. Warsaw, 1938. (With a Summary in English.)

A detailed account is given of field and laboratory observations, carried out in Pulawy (central Poland) in 1931–34, on infestation of hops and millet (*Panicum miliaceum*) by *Pyrausta nubilalis*, Hb. All stages of the moth are described. In Poland, the larvae have been found on hops, millet, maize, hemp (*Cannnabis sativa*), *Artemisia vulgaris*, *Panicum crusgalli*, and *Amarantus retroflexus*. Their occurrence on the first five food-plants near Pulawy and the severity of the infestation are discussed, and records are given of the infestation of these plants in other districts and in countries outside Poland.

In the environs of Pulawy, where the moth has one generation a year, hops and millet are chiefly attacked, and maize only when growing close to infested millet. Larvae in millet overwinter in both stubble and stems, whereas those in hops usually hibernate only in the bines, though there is evidence that they can also do so in the stumps. Overwintering larvae also occurred in the stems of wild hops and *Artemisia vulgaris*. Pupation usually takes place in May. The flight period varies according to weather conditions; in 1933, when low temperature prevailed in April and May, it lasted from about mid-June to about 10th August, whereas in 1934, in which the spring was very warm, it lasted from the beginning of May to about the end of July. Correspondingly, oviposition on millet began on 1st July in 1933 and on 12th June in 1934, when eggs were found on hops as early as 25th May. On millet, the eggs, which are usually laid in batches of 2–22, are deposited chiefly on the lower surface of the leaves, and sometimes on the stems, when the plants have at least five leaves and are at least 3 ins. high. On hops, they were invariably laid on the lower surface of the leaves. In the insectary, the total number of eggs laid by individual females varied from 3 to 377, with an average of 83. The larvae feed at first on the lower surface of the leaves, and also on the sheaths of the stipules of hops and in the ears of millet. They probably reach the second instar on hops and the third on millet before entering the stems. The maximum numbers of larvae found in a stem were 15 in hops and 3 in millet. They usually occurred in the lower part of the stem in millet and in the upper half in hops, though never as high as the thin tips. The stems of millet were abandoned more often than those of hops, probably partly owing to insufficient food; the larvae migrate from one millet plant to another and also to adjoining maize, hemp or *A. vulgaris*.

The character of the damage caused is discussed in detail. In millet, the chief stems are more often attacked than the side shoots. They often wither or break, chiefly in the lower parts, or do not form ears. In experimental plots of millet sown on 25th April, the absolute loss in weight of grain due to infestation was 9·5 per cent. in 1933 and 3·3 per cent. in 1934, and the decrease in weight of 1,000 grains was 8·8 and 3·6 per cent., respectively. Millet was more infested when growing near hops and when sown early. Weedy fields were less infested, possibly because the millet did not develop so well. The intensity of infestation of hops varied from 58 to 76 per cent., the

thicker, more productive shoots being more often attacked. In a comparison of a small number of infested and healthy shoots, the difference in the average weight of cones obtained was not significant, but field evidence indicates that infestation may result in a complete destruction of the yield of cones, as was the case in a hop garden of about 3 acres, while in an adjoining smaller one the yield of cones was only a quarter of the normal.

Parasites reared from the larvae of *Pyrausta* were *Eulimneria crassifemur*, Thoms., *E. rufifemur*, Thoms., *Angitia* (*Dioctes*) *punctoria*, Rom., *Microgaster globata*, L., *Macrocentrus abdominalis* var. *pallidipes*, Nees, *Ceromasia juvenilis* (Rond.), Girschn. [*cf. R.A.E.*, A **19** 131], and *Zenillia* (*Exorista*) *mitis*, Mg. The control measures recommended are directed mainly against the hibernating larvae. In the case of millet, they consist in harvesting early to reduce loss due to breaking of the infested stems ; cutting the stems as low as possible and chopping up the straw ; and ploughing to destroy the larvae in the stubble. In the case of hops, burning the bines in autumn is very important, and as some of the larvae may hibernate in the stumps, these should be cut early in the spring. If *Artemisia vulgaris* or wild hops are growing near fields of millet or cultivated hops, their stems should be cut down and burnt between the end of September and May ; the plants themselves should not, however, be eradicated, as they serve to divert the moths from the crops.

Baker (A. D.). **Roundworm attacking Pea Moth.**—*Canad. Ent.* **70** no. 6 p. 132. Orillia, June 1938.

It has been found that considerable mortality of larvae of the pea moth, *Cydia* (*Laspeyresia*) *nigricana*, Steph., hibernating in their cocoons in the soil on the Gaspé coast is caused by a Nematode of the genus *Neoaplectana*.

McLeod (J. H.). **The Control of the Greenhouse Whitefly in Canada by the Parasite** *Encarsia formosa* **Gahan.**—*Sci. Agric.* **18** no. 9 pp. 529–535, 6 refs. Ottawa, May 1938.

The difficulties attendant on the artificial control of *Trialeurodes vaporariorum*, Westw., and general considerations on biological control of pests in the greenhouse are discussed. *T. vaporariorum* may be controlled by *Encarsia formosa*, Gah. [*cf. R.A.E.*, A **15** 240], which was introduced into Canada from England [**18** 599]. After rearing 7–9 generations of the host and parasite in a greenhouse through the autumn, winter and spring, it is advisable to rear a few generations out-of-doors from June to September. In the autumn, young tomato plants growing in cold frames are artificially infested with adult whiteflies and the parasites are introduced after about two weeks. The infested plants are moved into the greenhouse when there is a danger of frost. In summer, shade, other than that provided by the food-plant, is necessary. Of the summer food-plants used, the most suitable were, in order of suitability, tobacco (cigar leaf type) [*cf.* **17** 257, 406], tomato and squash. Rearing under artificial light was tried for 3 years, but was discontinued as both hosts and parasites were attracted by the lights and large numbers were killed. In Canada, the proportion of *T. vaporariorum* increased at temperatures between 50 and 60°F., and that of *E. formosa* at temperatures between 60 and 75°F. A mean temperature below 50 or above 75° F. is

unsuitable for either host or parasite, but a comparatively low temperature from October to the end of January is necessary for satisfactory growth of the plants. A night temperature of 58° and a day temperature of 60° or more is satisfactory for plant and parasite. After January, the temperature may be raised to a mean of 65° or higher. Although hibernation was not induced, development of the late larval and pupal stages of *E. formosa* was retarded by storage at low temperatures, the average period from egg to adult increasing from 28 days at 60–70° to 51 days with storage for 35 days at 42°. Complete emergence of *E. formosa* was obtained at relative humidities ranging from 30 to over 80 per cent., but adult life is considerably shortened by low humidity. The procedure followed in distributing the parasites from the Dominion Parasite Laboratory, Belleville, Ontario, is described. In 1935, 1936 and 1937, 230,800, 326,160 and 602,000 parasites were sent out.

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CONTENTS.

PAGE

AFRICA : Descriptions of some Eulophids 610
AFRICA, EAST : *Pseudococcus kenyae* on Coffee, etc., in Kenya 592
AFRICA, EAST : Biological Notes on some Coccinellids 611
AFRICA, ITALIAN EAST : A Record of Rosette Disease of Ground-nuts ... 592
AFRICA, NORTH : Control of *Stromatium fulvum* in Furniture in Egypt ... 591
AFRICA, SOUTH : Infestation of Maize by *Calandra oryzae* in S. Rhodesia 608
ARGENTINA : Possible Transmission of a Disease of Orange by Mites ... 581
ARGENTINA : A Thrips transmitting a Disease of Tobacco and Tomato ... 581
AUSTRALIA : *Leptocneria reducta* on *Melia azedarach* in New South Wales 582
AUSTRALIA : Control of *Trialeurodes vaporariorum* by *Encarsia formosa* ... 582
AUSTRALIA : *Penthaleus major* and *Halotydeus destructor* in Tasmania ... 582
AUSTRALIA : The Regional and Seasonal Incidence of Grasshopper Outbreaks 583, 584
AUSTRALIA : A Review of Data on *Phylloxera* 608
AUSTRALIA : A Regulation against *Cydia* spp. in New South Wales ... 608
BRITISH ISLES : Insects observed on Fruit Trees in England in 1937 ... 612
BRITISH ISLES : *Capitophorus fragariae* on Strawberry 613
BRITISH ISLES : Tests of impregnated Bands against Pests of Apple ... 613
BRITISH ISLES : Sprays against *Hoplocampa flava* on Plum 614
CANADA : Mechanical Spreaders for Grasshopper Bait 590
CANADA : A Nematode Parasite of *Cydia nigricana* in Quebec 623
CANADA : Utilisation of *Encarsia formosa* against *Trialeurodes vaporariorum* 623
CZECHOSLOVAKIA : The Bionomics and Control of *Rhynchites pauxillus* 620
FRANCE : The Introduction of natural Enemies of *Leptinotarsa decemlineata* 594, 595
FRANCE : Fumigation of Potatoes against *Leptinotarsa decemlineata* ... 597
FRANCE : Spraying with Bacteria against Vine Moths 619
GERMANY : The Problem of Control of *Melolontha* 599
GERMANY : The Importance of *Hylotrupes bajulus* 599
GERMANY : The Distribution of *Phylloxera* in 1937 601
GERMANY : Studies on the Wheat Gall-midges 619
HAWAII : The Life-history of *Pseudococcus brevipes* 570
HAWAII : The High Susceptibility of polished Rice to *Calandra oryzae* ... 584
HAWAII : The Occurrence of *Antonina indica* on Sugar-cane 585
HAWAII : Experiments on the Cause of Stem Galls of Sugar-cane 585
HAWAII : The Introduction of Parasites of Armyworms 586
HAWAII : Natural Enemies of *Pseudococcus nipiae* introduced from Mexico 586
HOLLAND : Cold Storage against Pests of Stored Products 599
HOLLAND : The Causes and Detection of Outbreaks of *Diprion pini* ... 621
INDIA : Bark-eating Caterpillars on Tea in Assam 601
INDIA : Studies on Trypetids 602
INDIA : Parasites of *Scirpophaga* in Madras 602
INDIA : A Cecidomyiid infesting *Moringa* in Madras 603
INDIA : *Phthorimaea heliopa* on Tobacco in Mysore 606
ITALY : Phases in *Dociostaurus maroccanus* 592
ITALY : Equipment for fumigating Plants and Cases of Fruit 593
ITALY : Observations on Spring Emergence of *Cydia pomonella* 593
ITALY : Work on the Control of *Cydia molesta* 594
ITALY : A Sawfly attacking Iris 598
JAPAN : The Temperature Limit of Activity of *Anthonomus bisignifer* ... 603
JAPAN : Sun-spot Numbers and Outbreaks of *Lymantria dispar* 604
JAPAN : Pests of Pears in Shizuoka in 1937 604
JAPAN : The Food-plants of *Aonidiella aurantii* 604
JAPAN : A Geometrid attacking Mulberry 604
JAPAN : Crops injured by Adults of *Aserica japonica* 605
JAPAN : Insect Pests of Vegetables 605
JAPANESE MANDATED ISLANDS : Records of Coccids from Korror (*Title only*) 624
KOREA : A Cecidomyiid injurious to Pear 605
LOOCHOO ISLANDS : A Toad introduced against Insect Pests 605
MANCHURIA : Oviposition of *Cydia glycinivorella* on Pods of Soy Bean ... 606
NETHERLANDS INDIES : Pests of Tobacco in Sumatra in 1937 603
NETHERLANDS INDIES : Studies on the Biology and Classification of Mealybugs 606, 607
POLAND : Infestation of Millet and Hops by *Pyrausta nubilalis* 622
RUMANIA : *Locusta migratoria* in the Danube Delta 610
RUSSIA : *Anisoplia austriaca* attacking Cereals and its Control 617
RUSSIA : Pests of *Taraxacum kok-saghyz* and *T. megalorrhizon* 618
RUSSIA, ASIATIC : The Damage caused by the Flax Weevil in Siberia ... 601
RUSSIA, ASIATIC : *Oscinella frit* breeding in *Phragmites* in Azerbaijan ... 617

CONTENTS—*cont.*

	PAGE
SWEDEN : The Estimation of Populations of Bark-beetles in Forests ...	611
SWEDEN : Wood-destroying Insects in public Buildings (*Title only*) ...	624
URUGUAY : A new Parasite of *Cydia molesta*	582
U.S.A. : Maintenance of Adults of *Rhagoletis pomonella* in Cages... ...	561
U.S.A. : *Chionaspis furfura* on Apple and its Control	561
U.S.A. : Control of *Eucosma ocellana* by Oil containing Dinitro-o-cyclohexylphenol	562
U.S.A. : *Sparganothis sulfureana* on Cranberry in New Jersey	562
U.S.A. : Imported Maize in Relation to *Heliothis armigera* on Long Island	564
U.S.A. : Tests of Sprays and Dusts for Potatoes	564
U.S.A. : *Listronotus latiusculus* on Celery in New Jersey	565
U.S.A. : Cubé Powders against Bean Insects	566
U.S.A. : The Bionomics of *Attagenus piceus*...	568
U.S.A. : Flooding for Control of Wireworms in California	569
U.S.A. : Tests of Insecticides against *Chalcodermus aeneus*	572
U.S.A. : *Aphomia gularis* infesting dried Prunes in California	573
U.S.A. : Dormant Oil Sprays against *Glossonotus crataegi* on Apple ...	574
U.S.A. : Cottonseed-hull Bran in Grasshopper Bait...	574
U.S.A. : Solvents for Derris Resinate in Oil Sprays against Coccids ...	574
U.S.A. : Methyl Iodide as a Fumigant	575
U.S.A. : Massing of a Coccinellid at Summits of Mountains	575
U.S.A. : Organic Compounds toxic to Larvae of *Cydia pomonella*... ...	575
U.S.A. : The Distribution of Elm Bark-beetles in Massachusetts... ...	576
U.S.A. : Transmission of Sugar-cane Mosaic by *Toxoptera graminum* ...	577
U.S.A. : Aphids transmitting a Mosaic Disease of Chinese Cabbage ...	577
U.S.A. : *Paratrioza cockerelli* and its Control in Wyoming...	578
U.S.A. : Mushroom Pests and their Control	579
U.S.A. : Miscellaneous Pests in 1937	580
U.S.A. : *Coccus mangiferae* on Mango in Florida	587
U.S.A. : Pecan Insects of northern Florida	587
U.S.A. : Zinc Sulphate in Sprays for Peach and Apple	587
U.S.A. : An Outbreak of *Dendrotettix quercus* in New Jersey	588
U.S.A. : *Solenopsis geminata* and its Control in California...	588
U.S.A. : A Hawaiian Elaterid in California	589
U.S.A. : The Biological Control of *Stilpnotia salicis*	589
U.S.A. : Spiders and Coleoptera found associated with Maize	590
U.S.A. : Tests of Bases and Poisons for Grasshopper Baits ... 574,	608
U.S.A. : The Question of Risk to Livestock of Grasshopper Control Work	609
U.S.A. : The Control of *Empoasca fabae* on Ground-nuts	609
U.S.A. : Bacteria from the Gut of Larvae of *Agriotes mancus* (*Title only*)	624
U.S.A. : Patents relating to Pest Control, January–June 1938 (*Title only*)	624
Sorption of Hydrocyanic Acid by different Insects	567
Toxicity of Hydrogenated Pyrethrins to the Housefly	567
The Complexity of Calcium Arsenate	567
Effects of Carbon Dioxide on Toxicity of Fumigants to *Tribolium*... ...	571
Difficulties encountered in Field Dusting Experiments	572
A Light for collecting nocturnal Insects	573
The Synonymy of *Euscepes postfasciatus* (*batatae*)	576
Rhogas unicolor, a Braconid Parasite of *Stilpnotia salicis*	576
New Records of Distribution and Food-plants of *Myzus ornatus*	589
A melanic Mutation in *Schistocerca gregaria*	590
Infestation of Locusts by *Aspergillus flavus*	591
The Effect of Humidity on Sex Ratios of *Pseudococcus citri*	598
Infection of *Plodia interpunctella* with a Schizogregarine	598
Colorimetric Methods for determining Dinitrocresol and Pyrethrin I ...	600
Experiments to elucidate the Action of Arsenic on Leaves...	600
Standard Insects for the Laboratory Testing of Insecticides	610
Three new injurious Weevils	612
Spray Supplements and Retention of Lead Arsenate on Apples	613
Aphid Transmission of some Plant Viruses	615
Studies on Constituents of *Derris*	616
A List of recently proposed Aphid Genera (*Title only*)	624
The Alimentary Canal of *Procriphilus tessellatus* (*Title only*)...	624
Studies on Anatomy and Histology of *Schistocerca gregaria* (*Titles only*)	624
Animals injurious to Books (*Title only*)	624
LEGISLATION : A Regulation against *Cydia* spp. in New South Wales ...	608

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